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NOTES AND COMMENTS

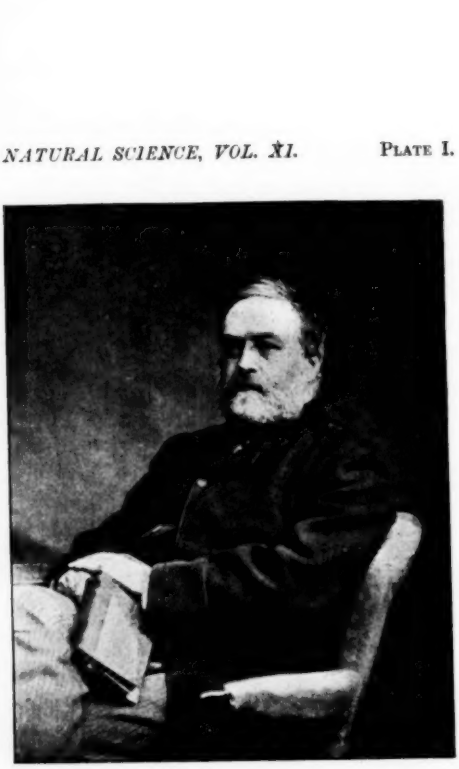
The Cambridge Graces

On few recent educational questions have we felt such difficulty in forming an opinion as on the proposal that the women students at Cambridge should be granted the degrees for which they may have passed the examinations. Anxious that the opportunities for women's education should be extended in every way, our natural sympathies were in favour of the proposals. There can be no doubt that those Girtonians and Newnhamites who enter the educational profession would find it a great advantage to have a Cambridge degree. To refuse it to women who have resided at Cambridge for the necessary number of terms, and have passed all the prescribed examinations, seems to us unfair and almost churlish. Women who have done the same work and stood the same tests as men, should surely be allowed the same certificate of efficiency. It seems to us hopeless to expect that popular opinion will ever estimate a Girton certificate as of equal value to a Cambridge degree, while the university refuses the latter. The present position of women students at Cambridge seems to us anomalous, illogical, and very unfair. But we doubt if the proposed changes would have improved matters. No one denies that had the graces been passed, there would have been a great increase in the number of women students at Cambridge. It is affirmed by some Cambridge authorities, whose opinions are usually entitled to respect, that the admission of women would have been followed by a considerable decrease in the number of male undergraduates. Suppose that in ten or twenty years' time, there are half as many women students as men. It would then be intolerable that the tutors and lecturers at the women's colleges and halls should have no voice in arranging the courses of study. If women be allowed the examinations and degrees, and form a third of the registered students, it would be quite unfair that they should not be eligible for all prizes and scholarships, and that their interests should not be protected by direct representation on the

boards of studies. We should not grudge the women any prizes that they won. The competition of the best women would do the men nothing but good. The danger is that alterations would be made in the interests of the weaker of the women, which might enable men to gain degrees with even less work than at present. Moreover, a course of study suitable for men may not be suitable for women. So long as women only enter for the tripos examinations, this objection is not serious. But if women are to have degrees, it would be absurd to allow men to take an easy poll degree, and restrict women to the tripos. The training for an ordinary Cambridge degree may not be an ideal education for men, although it may do well enough for the average curate and country gentleman. But in an education of that standard the requirements of men and women are very different. If women are to be admitted to poll degrees, then alterations in the examinations for them ought to be made. Hence we are inclined to prefer a separate university for women to a mixed university, at which both men and women would have to put up with an hermaphrodite education suitable for neither. Moreover, if women be allowed to enter the university and share in the scholarships, there is no logical reason why girls should not be admitted in separate classes to the public schools, to the students of which so many of the best scholarships are restricted.

The Woman of the Future

One thing is still lacking to "the new woman." It is a beard. But this, according to Dr A. Brandt, she may hope to have in the course of some thousands, possibly hundreds, of years. Many women have beards already. Some take a pride in them, and utilise them as a source of income; others keep them in check by the use of depilatories, of forceps, or even a razor. As for moustaches they are so common as to pass without remark, and a tender shade upon the upper lip of a brunette may even be regarded as an added beauty. Still, at the present period in the evolution of our race, it is for the most part in old age that the beard comes to woman. The beard does not appear in man before puberty, and increases in strength with age, often compensating for a loss of hair on the head. Dr Brandt, therefore, writing in the *Revue Scientifique* for May 15, regards the beard not as an ancestral, but as in part a second and in part a senile character. Like other characters that first appear late in the life of individuals, it is likely to be accelerated in its development. In other words, hair will appear on the face at an earlier and earlier age, as time goes on, both in men and women. "Perhaps a day will dawn when we shall think a moustache in a woman less ugly than a bust deformed by the corset."



T. Wm. Mason

The Contributors to the 'Challenger' Reports

The fifty volumes of the 'Challenger' reports having been recently completed, a complimentary album was presented to the editor, Dr John Murray, by his colleagues. The album was itself a work of art, but its chief interest lay in the circumstance that it contained the photographs of all who had contributed to the literature of the Reports. As some of these authors are no longer among us, and others are dispersed over the four quarters of the globe, it was an arduous undertaking to fill up this portrait-gallery of scientific worthies. But Mr W. E. Hoyle, as Hon. Secretary to the presentation committee, met with the friendliest response to every application, and, with the assistance of Mr Walter Crane in the artistic department, successfully coped with all the difficulties that arose, whether expected or unexpected. After so much trouble had been expended, the happy thought occurred to Mr Hoyle that many who might never have a chance of seeing the original album, gleaming in purple and gold, would welcome an opportunity of possessing a copy of its contents. The Committee warmly approved of this suggestion, and the result is seen in a thin quarto volume (price, 12s. 6d.), uniform in size and binding with the reports. It contains reduced copies of the 88 portraits on 19 plates, together with reproductions in black and white of Mr Walter Crane's designs for the cover and dedication. As a specimen of the portraiture we are enabled to show our readers a likeness of the late Sir C. Wyville Thomson, the original director of the civilian staff. Whether the small edition of 200 copies will suffice for all who will wish to possess this interesting volume may be doubted. The publishers are Messrs Dulau & Co.

Phenacomys

The genus *Phenacomys* has no doubt existed at least as long as the genus *Homo*, and specimens of this small vole may even have been known to man, and have been hoarded by that acquisitive animal in his museums for a considerable period. We know, in fact, that a specimen obtained and presented by Mr J. K. Lord of the North American Boundary Commission, has been in the British Museum since 1863. None the less so short a time as eight years ago, zoologists were unaware of the existence of this genus, although the suspicions of a few may have been aroused by Nehring's description, in 1883, of some bones and teeth found in a cave in Southern Hungary. Within the last eight years, however, no less than nine living species of the genus have been described, all from Boreal North America. Ninety-five specimens have been at the disposal of

Mr Gerrit S. Miller, jun., who, in the *Proceedings* of the Biological Society of Washington (xi., pp. 77-87, April 21, 1897), considers that there are six valid species. These fall naturally into three groups, each of which occupies a different geographic region. They generally inhabit dry, grassy plains and mountain parks, and, except for some small characters in the teeth, are much like the ordinary *Microtus;* from the humid coast district of Oregon, however, there comes a long-tailed form, which appears to be strictly arboreal.

The Geographical Distribution of the Dragon-flies

One of the greatest surprises in store for the student at the outset of his study of zoo-geography is the discovery that animals so different in their powers of locomotion as mammalia and birds agree nevertheless so closely in geographical distribution, that a map representing the zoological areas of the one class, will, in its broad outlines, be equally applicable to the other. The obvious inference to be drawn from this circumstance, the inference, namely, that the actual means of progression, whether it be flight or swimming or running, are far less important factors in determining the dispersal of species than one would be led on *à priori* grounds to suppose, is still further supported by a recent paper on "The Geographical Distribution of Dragon-flies," published by Mr G. H. Carpenter in vol. viii. of the *Scientific Proceedings of the Royal Dublin Society*. Though this paper is chiefly nothing but a compilation from Mr W. F. Kirby's catalogue of the Odonata, it is nevertheless a valuable piece of work, since it represents in a concise and intelligible form the range of all the genera of the great order of powerful-flying insects, and is accompanied by a map showing how closely in the main their distribution tallies with that of the other orders and classes of terrestrial animals that have been faunistically studied. Seven regions are recognised: the Holarctic, comprising the Palaearctic of Sclater and Wallace, *plus* the Nearctic almost down to the fortieth parallel of latitude; the Ethiopian; the Mascarene; the Oriental; the Australian, including New Zealand; the Sonoran; and the Neotropical. It is interesting to note that there is no evidence of a Mediterranean region in the Old World corresponding to the Sonoran of the New, and that the species from Madagascar are no more Ethiopian than Oriental in their affinities. The advocates of Lemuria may get some satisfaction from the latter circumstance; but those who are in favour of an Antarctic area will not gain much support from the dragon-flies, since the species of these insects that inhabit Patagonia, Cape Colony, and New Zealand bear no witness to a former land connection between these countries.

The Arthropods of Funafuti

Part II. of the "Memoir on the Atoll of Funafuti," based on collections made by Mr Charles Hedley, was published by the Australian Museum, Sydney, on February 25, 1897. Its arrival gives us rather a shock, for we were under the impression that, when the Royal Society invited the Australian Museum to send a naturalist on their expedition, a stipulation was made that the representatives of the Royal Society should retain the right of prior publication. If such an agreement was not made, it ought to have been, in the interests not merely of justice, but, as this publication proves, of science also.

Mr W. J. Rainbow undertakes to describe the whole of the land arthropods, and his knowledge is scarcely commensurate with the undertaking. Whose knowledge could be? Probably it is not Mr Rainbow who is to blame, but the authorities of the Australian Museum, who, like the head officials in many other scientific institutions, seem to think that they have only to say to a subordinate, "Do!" and he doeth it, even though it be a task for which years of training are necessary. In recent zoology, just as in palaeontology, work of this kind can only be done well by the specialist having at his disposal large collections and complete libraries. We have no wish to be hard on an obedient servant, but we must justify our remarks by a few selected criticisms of Mr Rainbow's work.

On p. 97, the syllable "Nob." following "genus *Lispe*," is, no doubt, a printer's error for 'Latr,' since Latreille founded this genus in 1796. We let this pass, but discover from the figure that the single female specimen, here made the type of a new species of *Lispe*, is not a *Lispe* at all, and does not even belong to the same family. So far as may be judged from the figure, it is a *Coelopa* (family, Phycodromidae.) "Nob." again, this time following "genus *Ebenia*"! Mr Rainbow may have described a genus under the name *Ebenia*, though he gives no reference to the place where he published it; but the real *Ebenia* was founded by Macquart for a Brazilian species having no sort of affinity with the two specimens here described under that name. It is impossible to say whether the four species of Diptera described, three on the evidence of single specimens, are new or not; the descriptions are too short to be of value, the figures are atrocious, no reference is made to allied forms, and the author, while including family characters, ignores those of specific rank. With the exotic Muscidae (*sens. lat.*) in their present state of chaos, every attempt of inexperienced workers to describe new species is a distinct retarding of science.

Of Arachnida, 88 specimens were secured, and these are

distributed by Mr Rainbow into 25 species, of which 15 are new. Fifteen! At any rate *Epeira ventricosa*, and probably some of the other species of *Epeira* described as new, appear to be nothing but representatives of that wide-spread, highly variable, and well-known species *Epeira theïs;* while *Hyllus ferox* and *H. audax*, supposed new species, have been placed in a wrong genus, and are probably old friends.

The scorpion described as "*Buthus brevicaudatus* sp. n." belongs to a totally different family from *Buthus;* it is perhaps the best known of all scorpions, and more than a century ago Fabricius named it *Hormurus australasiae.*

Fortunately for Mr Rainbow and for us, he does recognise that some of the species found on Funafuti are neither new nor peculiar to that island, but that they have been introduced by man. Among these are certain mosquitoes, which the natives catch with a kind of racquet, the meshes of which are made of the glutinous snares of orb-weaving spiders. White ants, *Calotermes marginipennis*, attack the coco-palms at a height of three to six feet above the ground, tunnelling their way through; as a result the trees are snapped off by the gales. It is probable that both the tree and the termite were introduced by human agency, *via* Hawaii, about two centuries ago.

The Crustaceans and Echinoderms of Funafuti

These animals have fallen into the more experienced hands of Mr T. Whitelegge. The Crustacea are the lords of the atoll, swarming into all vacant places. "The *Coenobita*," says Mr Hedley, "wander across from shore to shore, and dispute any stray edibles with the rats. Some crabs even take up their residence in the tree tops of Pandanus, while, as everybody knows, *Birgus* is as much at home on a palm bole as a squirrel on an oak. . . . Human habitations are not even secure from crabs. . . . Active as they are during the day, it is at night that the land crabs hold high carnival. On the beaches the Crustacea were everywhere abundant, particular species possessing each their special zone. About high tide mark on the windward shore promenaded *Grapsus maculatus*, a crowd of which scattered before the footsteps of a visitor, and sought refuge under loose coral blocks or in deep pools. Rolling over a slab of dead coral rock anywhere between tide marks, exposed the haunt of a little community of *Petrolisthes dentata* and *Leiolophus planissimus.* Intercepted in their efforts to escape, these would flatten themselves down to the surface of the stone so closely that the collector's fingers with difficulty grasped them. The deeper rock-pools at the border of the reef-flat, the chief home of *Salarius*, were usually

tenanted by a few *Calcinus elegans*, whose brilliant red, blue, and white claws distinguished it as the dandy of the company. This species is never out of the range of the rough waves. The extreme windward portion of the reef left dry at low tide was but rarely attainable; *Aniculus*, whose bristly claws usually protruded from a stolen *Turbo* shell, was a distinctive feature of this zone. In the honey-combed pits of the millipore mounds that breasted the surf, cowered *Daira perlata*. The close resemblance of colour and contour to the surrounding rock rendered this crab difficult to detect, and when seen the creature's powers of adherence and the sweep of the Pacific rollers rendered it as difficult to seize."

Geograpsus crinipes, Dana, occurred in association with *Coenobita* and *Cardisoma*, at a distance from the sea, among broken coral rocks shaded by vegetation. This is the first instance of a grapsoid crab living wholly on dry land, and it displays interesting adaptations to terrestrial conditions. It breathes by hair-lined pores between the bases of the second and third pairs of walking-legs; and its colour, a dirty yellowish-white, harmonises with that of the coral fragments.

Athelgue aniculi is a new Epicarid living on *Aniculus typicus*, a hermit crab that lives in the shell of *Turbo setosus*, on the outer edge of the reef, most exposed to the surf.

The collection of echinoderms comprises 130 specimens, representing 19 species, mostly common forms:—7 echinoids, 3 asteroids, 3 ophiuroids, 6 holothurians. A detailed description is given of two specimens referred to *Culcita acutispina*. Most specimens of this starfish, as also of *Anthenea acuta*, common in Port Jackson, are unsymmetrical when dredged up; but, if placed on a level surface in sea-water, they soon regain their natural form, and may be killed in that state either by flooding them with fresh water or by placing them in strong spirit. Neglect to take these precautions may have led to the establishment of invalid species.

Granivorous Insects

Another of the excellent Bulletins (N.S. No. 8) issued by the Entomological Division of the U. S. A. Department of Agriculture has reached us. It is written by Mr F. H. Chittenden, and deals with insects which have been observed in North America to injure stored grain and other vegetable products. It is of interest to find included among these, certain beetles of the family Dermestidae and their grubs. These insects, which include the well-known 'Bacon Beetle,' have long been notorious as devourers of dried animal matter, but have not attracted attention as vegetarians. It appears, however, that some of them can find sustenance on stored grain, meal, and cloth.

A Study in Parasitism

Bulletin No. 5 (Technical Series) of the same department contains an exhaustive account by Mr L. D. Howard of the insect-enemies of the white-marked tussock moth (*Orgyia leucostigma*). The hairy caterpillars of this moth have become, during recent years, highly injurious to foliage trees in the cities of the northern States. It appears that the vast multiplication of these caterpillars began with the introduction of the European sparrow. This bird has well-nigh exterminated other caterpillars which used to compete with the 'tussocks' for a livelihood on the trees; it will not touch the hair-protected 'tussocks' itself, but it has largely driven out the native birds which used to feed on them. Fortunately, however, an army of insect-parasites keep the caterpillars from increasing beyond all bounds. Fifteen species of Hymenoptera and six of Diptera are described as laying their eggs in either larva or pupa of the *Orgyia*. These parasites are in their turn subject to attack by thirteen species of minute Hymenoptera. An alarming increase of the 'tussocks' at Washington during the summer of 1895 was accompanied by a corresponding increase in the parasites, so that the vast majority of the caterpillars were destroyed. The next year, however, owing to the work of the secondary parasites, the 'tussock' recovered its ground to a considerable extent. Two species of tiny hymenoptera were proved to be 'tertiary' parasites, their grubs devouring those of the secondaries. Finally, eleven species of Diptera act as scavengers, their grubs feeding on the dead pupae and cocoon-masses of the contending insect-armies.

A Study in Commensalism

It is cheering to turn from this summary of conflict and slaughter to another side of insect-life lately investigated by Mr C. Janet. In a little work of 62 pages ("Sur le *Lasius mixtus*, l'*Antennophorus uhlmanni*, &c.": Limoges, 1897) he describes the relations which subsist between social ants (*Lasius*) and certain gamasid mites and other arthropods which are found in their nests. The mites of the species *Antennophorus uhlmanni* are carried about by the worker ants; in their penultimate and adult stages they seem unable to make their own way about the nest, and wait feeling with their long front legs for an ant to which they can attach themselves. An ant normally carries three of the mites—one under the head and one on either side of the abdomen; these positions are the least inconvenient possible to the ant. The mites feed entirely on liquid disgorged by their hosts. An individual under an ant's head naturally

draws his supply from the insect's mouth, especially when she disgorges to feed a comrade. A mite carried on the abdomen of an ant taps, with his two front pairs of feet, another ant which happens to be near, and for thus asking obtains food. No benefit to the ants from the presence of these mites is suggested, and the relation bears the aspect of disinterested charity.

Another species of mite, *Discopoma comata*, is on the other hand a true parasite. These gamasids attach themselves to the ant's abdomen, pierce the intersegmental membrane, and suck food-supplies.

A bristle-tail or thysanure, *Lepismina polypoda*, plays the part of pickpocket in the ant-colony. He comes stealthily between two ants when one is feeding the other, grabs the drop of liquid nourishment in its passage, and makes his escape as quickly as possible to levy contribution on other couples until his hunger is satisfied.

The Pigments of the Decapod Crustacea

Another interesting contribution has just been made to our knowledge of the pigments of the decapod crustacea by Miss M. I. Newbigin (*Journ. Physiol.*, vol. xxi., pp. 237-257, May 1897). She discusses the predominant characteristics of the pigments of *Homarus vulgaris*, *Nephrops norwegicus* and *Astacus nobilis*. The conclusions arrived at support recent observations on the same subject, but a speculative tone mainly towards the end of the paper rather spoils the general effect.

Thus we cannot accept the conclusion "that there is some connection between the little known substance in the muscle and the formation alike of the blue pigment and of chitin." The conclusion also that the red lipochrome is present as a calcium combination in the shell is only speculation. The pigment is laid down there before calcification takes place: in fact pigment and calcium salt are more or less independent of each other.

While in the earlier parts of the paper a distinction is drawn between the yellow and red pigments, in the 'summary' the former is said to be partially derived from the latter "under the influence of certain reagents." A 'lipochromogen' is not a 'compound' of a lipochrome: it is a precursor of one. The return to Krukenberg's term 'hepatochrome' would certainly be unfortunate, as the organ in which such pigment or rather pigments occur is not a liver but mainly a pancreas, and although no band in red was recognised in extracts of the digestive gland by Miss Newbigin there is a chlorophylloid pigment, which is better named enterochlorophyll, present in most if not in all cases.

There is no mention of this spectrum given by the pigment itself

when the red hypodermis is examined by the spectrum eye-piece by means of reflected light.

We fail to find any evidence in this paper that the 'chemistry' of the crustacean pigments has been advanced beyond the old stage of solution and colour-change with reagents. What we want is isolation and purification before we can say that our knowledge of the subject has been largely increased.

However, in spite of these minor blemishes (and all new work must be imperfect), we welcome this paper and hope the author may continue her observations.

The Embryonic Shell in Bivalves

The shell, or rather pair of shelly valves of the young bivalve, that forms before the little creature is hatched, is usually very different in appearance to that enclosing the fully formed animal. The prodissoconch, as it has been termed, is small, unornamented, and may frequently be seen capping the umbones of the older shell. It has been considered the sole stage prior to the exclusion of the embryo from the egg-shell. Mr Félix Bernard, however, (*Comptes Rendus Acad. Sci. Paris*, vol. cxxiv. pp. 1165-8) has detected an earlier stage which he calls the *protostracum*, and he has been able to find this protostracum on the summit of each prodissoconch studied by him. The Glochidium stage in the Unionidae is the equivalent of this protostracum. In most cases the hinge-line of the protostracum undergoes no increase during the completion of the prodissoconch stage. It consists of a series of interlocking crenulations, for which Mr Bernard accepts Dall's suggested name of provinculum, with a central ligament pit. The development of the Heterodonts is so rapid, that, as a rule, the crenulations have no time to form, but are superseded by the true teeth, whose development has already been commented on in these pages (vol. ix. p. 358). This acceleration of development of the hinge is correlative with the earlier incubation of the individuals of this group, entailing an earlier use of the shell with a consequent stimulation of the hinge through function.

The free swimming larval stage, which has its foot adapted for creeping, and free mantel lobes, guiltless of siphons, and whose gills are situated in the rear, whilst it possesses the velum characteristic of all larval mollusca, is common to all Pelecypoda and representative of the ancestral form.

The Reproduction of Diatoms

The two chief methods by which diatoms have hitherto been supposed to reproduce themselves are (1) by simple vegetative

division, and (2) by the formation of so-called *auxospores*, which are usually the result of conjugation. The former method of division is of unusual interest in the diatoms, since, owing to the peculiar arrangement of their valves by which one fits inside the other, a formation of progressively smaller and smaller individuals is a necessary result of simple division. The growth in size of the valves is usually supposed to be impossible on account of their silicified nature. It is imagined, however, that the production of infinitely small individuals, which would obviously result from the continuance of such a method of division, is prevented by the interpolation of auxospore formation; by the latter means the diatom is given an opportunity of regaining its maximum size.

Mr George Murray, in a paper entitled "On the reproduction of some marine Diatoms" (*Proc. Roy. Soc., Edin.*, Dec. 1896), has, however, thrown new light on reproduction in this group. The author has observed in some marine forms a very interesting and totally new method of division. This form of reproduction was observed in *Coscinodiscus*, *Biddulphia*, *Choeboceros*, &c., but was followed out most fully in the first-mentioned genus. In *Coscinodiscus* the cell-contents divide by successive division into eight or sixteen portions, and these become rounded off and lie free in the mother cell like spores in a sporangium. Each of these portions becomes invested with valves showing the characteristic markings, and in fact becomes a young *Coscinodiscus*. These young forms ultimately escape from the parent cell, and are found floating free in the water as packets of eight or sixteen small individuals enclosed in a delicate membrane; later on the several individuals themselves become completely free. It is by this method of division that the enormous quantities of marine diatoms, occurring in many waters at certain seasons, are doubtless produced.

As mentioned above, diatoms are usually supposed to be incapable of superficial growth, owing to the silicified nature of their membrane; but, as Mr Murray points out, this view is hardly well founded. At all events, it raises the question of the nature of the membranes produced by the young diatoms inside the old valves. These diatoms must obviously be much smaller than the parent, and so, in the absence of growth, continued reproduction by this method would have as disastrous an effect on the size of the species as the method of simple division, and would similarly necessitate the production of auxospores. With this question in view Mr Murray investigated the nature of the membrane of the daughter forms, and his conclusion is that the valves are either not silicified or only incompletely so. There is thus nothing to prevent the further growth of these young diatoms to the full size of the species. That this later growth takes place is supported by observation, for the very small forms of

certain species of *Coscinodiscus* which are abundant at one season, disappear later in the year.

Plants and the Weather

We have received an interesting little pamphlet on the effects of weather upon vegetation, the subject of a recent lecture to the Bradford Naturalists' Society.

The lecturer, Mr John Clayton, has made some simple but none the less instructive experiments, the results of which he put before his audience. The effects of sunshine are, as we should expect, very striking. Of twelve bean-plants, as like as possible in size and health, six were placed in the ground where they would catch all the sunshine of the day; the other six were sheltered by a boarding which effectually prevented any rays from falling upon them. When freshly gathered in October the weight of beans and pods grown in sunshine was more than three times as great as in the case of those grown in the shade (99 : 29), while the weight of the dry beans was in a similar proportion (16 : 5). The experiment was continued in succeeding years. Thus in 1892 the fresh weight of beans and pods grown from the sunshine-grown seed of 1891 was half as much again, as in the case of plants from shade-grown seeds—all being grown in sunshine and under precisely similar conditions in the second year. In the fourth year plants with an exclusively shady ancestry produced flowers, but failed to mature fruit.

A series of measurements illustrating the contraction of trees in frost was made in the winter of 1894-5. A comparison of the girth of tree-trunks in October, when growth had ceased but before the frost set in, with the girth at 9 a.m. on February 8th, at a temperature of 3° F., showed an appreciable contraction under frost. In the sycamore it was from two to three sixteenths of an inch, in the elm from three to five sixteenths, in the oak from five to six sixteenths. On March 2, at a temperature of 39° F., the trunks had expanded to their original measurements. To this contraction under frost is due the frequent splitting of our forest trees.

An interesting review is also given of the distribution of sunshine, rain, &c., in the different months of the year; and various improvements are suggested for individual months, which we recommend to the consideration of the clerk of the weather.

Plant Chemistry

The chemistry of some common plants is discussed by Dr P. Q. Keegan in a recent number of *The Naturalist*. The buttercup owes

its brilliant golden hue to a pigment called carotin (from its presence in the carrot root), "which is amassed in discoidal bodies that nearly fill up the cells of the epidermis, especially towards the base of the petal; in other parts, especially when the flower is fully expanded, it seems diffused in oily droplets or amorphous granules." In either case the starch grains in the subjacent tissue act as a reflector, and contribute greatly to enhance the effect. The flower-heads contain a considerable amount of sugar, starch, calcium oxalate, and soluble phosphates, in these respects approaching more to the character of leaves than is usual. The stem and root of this buttercup (*Ranunculus bulbosus*) are remarkable for the presence of an acrid camphoraceous body easily decomposed into a volatile bitter principle (anemonin) and an acid, even during the drying of the plant, so that its original poisonous character disappears.

Bird's-foot trefoil (*Lotus corniculatus*), with the brilliant orange and crimson tints of its little papilionaceous flowers, is known to everyone. To produce this vividness and lustre the epidermal cells are swollen into papillae, and contain no less than three distinct pigments. There are the solid carotin corpuscles, and also two colouring-matters in solution in the cell-sap. One is a clear, yellow juice, the other is identical with the anthocyan of the rose. Where the latter predominates we get the deep red colour.

The tiny flowers of the cheerful little yellow bedstraw (*Galium verum*) contain carotin, much yellow resinous matter, and "a curious purplish substance (possibly purpurin) insoluble in cold alcohol or benzene after purification." The flowers also contain a species of ferment which, like rennet, has the power of coagulating boiling milk. A substance known as rubichloric acid is present, not only in the flowers but in the stem and root. It forms a colourless solution in water, but when boiled with a few drops of hydrochloric acid, suddenly produces a deep blue, then a green colour, and deposits a dense, dark green precipitate soluble in ammonia. The disc florets of the daisy are tinged with carotin granules; the crimson of the ray florets is due to a soluble pigment described as a tannin anhydride. The blue of the harebell and chicory is again a tannin derivative.

Two colouring matters are engaged in the decoration of the primrose. At the base of the petal-limbs, where the tint is more deeply orange, carotin granules are present; the rest of the corolla contains a pale yellow, soluble pigment. Although the tints are comparatively feeble, chemical analysis shows that the plant is capable of "an infinitely richer wealth of coloration" than it shows in our climate, since "it seems almost impossible to exhaust the flower heads of substances which yield vivid and powerful orange and yellow dyes."

On Willows

The March number of the *Botanical Gazette* opens with a useful paper by C. J. Chamberlain, entitled "Contribution to the life history of *Salix*." The author has worked out the development of the flower, and that of the microspores and macrospores, and their germination, the process of fertilisation, and the embryology in several species of willows growing in the northern United States.

In view of the results of the work of Treub, Nawaschin, and Miss Benson, on *Casuarina* and various genera of the so-called Amentiferae, considerable interest attaches to Mr Chamberlain's researches.

He finds that *Salix* shows none of those striking divergences from the usual course of events in the ovule, which have been demonstrated in the above-mentioned genera, and his results confirm previous views as to the primitive simplicity of the willow flower. A diligent search in buds, both of the male and female flowers, failed to reveal the slightest trace of a rudimentary perianth, such as might be expected were the floral simplicity the result of reduction. The path of the pollen-tube is perfectly normal, an entrance to the ovule being effected through the micropyle. The synergids have a strongly developed beak, and breaking through the embryo-sac, project into the micropyle and attract the pollen-tube.

Great difficulty was experienced in finding the antipodal cells in the embryo-sac; only in six cases out of several hundreds examined were they clearly seen. This leads the author to suggest that their reputed absence in *Casuarina* may be due to a similar difficulty. The course of cell-division, in the development of the embryo from the fertilised ovum, shows several differences in detail from that described by Hanstein for *Capsella*.

Some interesting sports were also noted. Besides the well-known mixed catkins, which were observed in considerable number on a vigorous plant of *S. glaucophylla* in three successive seasons, the writer describes and figures the growth of stamens inside the ovary, an occurrence hitherto unknown in *Salix*. These intra-ovarian stamens consisted generally of a one-celled stalked or sessile anther, borne on the wall of the carpel or on a placenta-like outgrowth. Occasionally these ambisporangiate ovaries had a perfectly natural appearance, but generally they were more or less deformed. The ovules were generally inverted (anatropous), their normal form; but occasionally upright (orthotropous) ovules were found, sometimes borne on a long stalk. Quite normal embryo-sacs and embryos were produced in these sporting pistils. Masters in his "Teratology" mentions only one authenticated case of the formation of stamens

within the ovary cavity, namely in *Baeckea diosmifolia* (a member of the myrtle family). Certain ovaries of quite normal external appearance contained numerous perfect or sometimes imperfect stamens, but no trace of any ovules.

Some Basic Dyke-rocks from Southern India

A recent issue of the *Records of the Geological Survey of India* (vol. xxx. part i.) contains a paper by Mr T. H. Holland dealing with certain basic dykes widely distributed in Peninsular India. On both geological and petrographical grounds they are correlated with the Cuddapah lava-flows, and they shew none of the effects of dynamic metamorphism so general in the older series of dykes referred to in the Dharwar system. The author treats the rocks under three groups: olivine-norite, augite-norite, and augite-diorite. The first consists essentially of olivine, enstatite, augite, and a basic plagioclase, with subordinate biotite. The second lacks olivine, and has more augite relatively to enstatite. In the third group biotite and usually enstatite have disappeared, a comparatively late crystallization of augite gives a tendency to the ophitic structure, and interstitial micropegmatite (sometimes with potash-felspar) is invariably present. Considerable variations occur, including transitions in the first group to peridotites and in the second to pyroxene-rocks. To each group there are 'hemicrystalline' equivalents corresponding with the rocks of plutonic habitus, and some of these present types not hitherto described but comparable with the limburgites or magma-basalts. These contain phenocrysts of olivine, of enstatite, or of both minerals in a dark compact matrix, largely of glass. The author also points out resemblances between the dyke-rocks and the Cuddapah lavas of which they are the probable equivalents.

The rocks styled augite-diorites seem to be practically identical with some which in this country have been termed quartz-bearing gabbros, etc., and the author makes an interesting comparison between the Indian examples and those of Carrock Fell, St David's Head, and Carlingford, with the well-known rocks of Penmaenmawr and the Whin Sill. He finds no evidence to support Professor Sollas' suggestion that the micropegmatite in such rocks is the result of a later injection of a distinct acid magma into minute veins and druses. He regards it as the final product of crystallization of the rock formed under somewhat changed ('aqueo-igneous') conditions, consequent upon the concentration of the original water in the residual magma. He suggests that distinct veins of granophyre traversing the rock, as described by Sollas in the Carlingford district, may be 'contemporaneous veins' rather than later injections,

and that even the considerable bodies of granophyre so often associated with gabbro in many districts may be due to the squeezing out of the residual magma under greater pressure. Such a hypothesis is certainly in accord with conclusions reached by quite different lines of petrological research, and has the advantage of bringing into relation a number of facts which are already well known. In this view differences of pressure due to more or less deep-seated consolidation are held to account for the association of the pyroxene-plagioclase-aggregate and micropegmatite, sometimes as contiguous and obviously cognate bodies of rock, sometimes as constituents of one and the same rock.

Taking Time by the Forelock

In these days when a determined effort is being made to settle once for all the dates of publication of generic and specific names, and when bibliographers like Mr Sherborn are devoting themselves to finding out the times of issue of classical works issued at irregular intervals and with no record of their appearance, one is horror-stricken to find a contemporary, held in high esteem by reason of the beauty of its illustrations and the scientific character of its letterpress, doing its best not merely to conceal the dates of the appearance of its fascicules, but actually endeavouring to give a false impression of punctuality.

The part of the *Journal de Conchyliologie* for October 1895, and dated '1st October 1895,' appeared in this country on 3rd Sept. 1896, and contained the descriptions of several new species.

In the issue for Jan. 1896, ostensibly published '1st Jan. 1896,' but received on 21st Dec. 1896, these are referred to in the following form: "[Genus, species, author], *Journal de Conchyliologie*, vol. xxxiii., 1895," thus giving the impression that they were published before they actually were, and laying traps for the unwary priority-student of the future. We have every sympathy with journals which try by prompt publication to give their contributors the fair reward of their labours, but—'fair play is a jewel.'

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I.

On the Distribution of the Pelagic Foraminifera at the Surface and on the Floor of the Ocean.

THE pelagic Foraminifera play a most important rôle in the economy of the present ocean, as well as in the geological history of our planet. Living specimens of these pelagic Protozoa are distributed everywhere in the surface waters of the open ocean, about fifteen or twenty species being met with in the surface waters of the tropics, and one or two dwarfed species are captured among the floating icebergs of the Arctic and Antarctic regions. The dead shells of these Foraminifera make up by far the larger part of the carbonate of lime present in the deep-sea deposits known as Pteropod and Globigerina Oozes, which cover about 50,000,000 square miles of the ocean's bed. In addition, they make up the major part of the carbonate of lime present in the other deep-sea deposits, such as Diatom Ooze, Radiolarian Ooze, Red Clay, and the deeper terrigenous deposits which are laid down in close proximity to continents and oceanic islands. Indeed, it may be said that, taken as a whole, nine-tenths of the carbonate of lime in marine deposits from depths greater than one hundred fathoms is derived from the dead shells of the pelagic Foraminifera.

When the *Challenger* set out on her cruise around the world, all the naturalists of the expedition believed that the habitat of the *Globigerinae* was on the sea-bed in deep water. This opinion was held by Wallich,[1] Carpenter,[2] and Wyville Thomson.[3] Gwyn Jeffreys,[4] however, took another view; he regarded the *Globigerinae* as surface organisms, and the Globigerina Ooze as made up of dead shells which had fallen to the bottom from the surface waters. The fact that M'Donald[5] and Major Owen[6] had captured several species of these Foraminifera in tow-nets at the sea-surface appears to have

[1] The North Atlantic Sea-bed. London, 1862; also Deep-Sea Researches on the Biology of Globigerina. London, 1876.

[2] *Proc. Roy. Soc.*, vol. xxiii. p. 234. 1875.

[3] *Proc. Roy. Soc.*, vol. xxiii. p. 32. 1874.

[4] *Proc. Roy. Soc.*, vol. xviii. p. 443. 1869.

[5] See Huxley's Appendix to Dayman's Report on Deep-Sea Soundings in the North Atlantic made in H.M.S. *Cyclops* in June and July 1857. London, published by the Admiralty, 1858.

[6] *Journ. Linn. Soc. Lond.*, vol. ix. (Zool.), p. 147. 1866.

been overlooked or forgotten. Huxley[1] discussed this question, and, while not coming to any definite conclusion on the subject, he held that the balance of evidence was in favour of those who maintained that the *Globigerinae* lived on the bottom of the ocean.

During the first few months of the *Challenger* Expedition the attention of the naturalists was almost wholly taken up with the

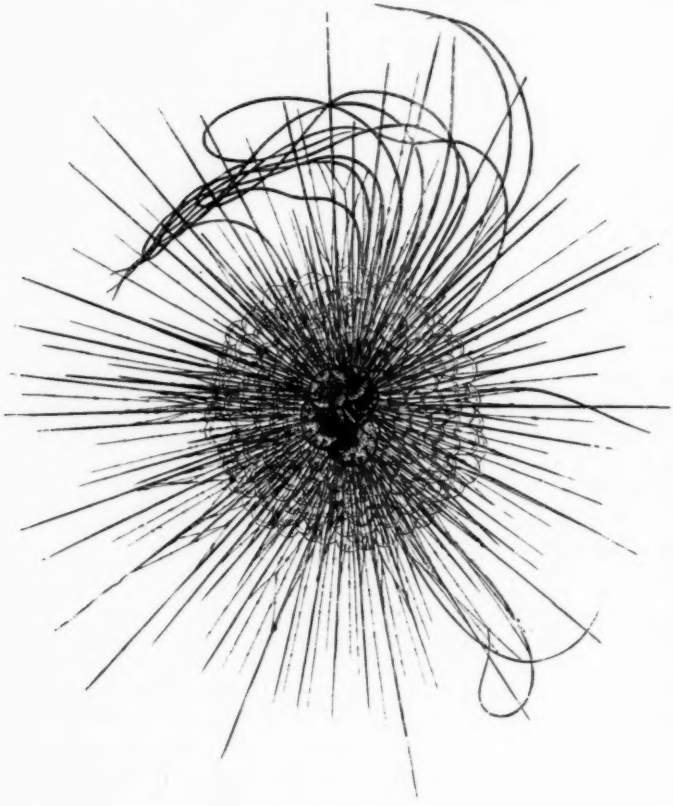


FIG. 1.—*Hastigerina pelagica* (d'Orbigny) [*murrayi*, Wyville Thomson] with floating apparatus and pseudopodia extended, as found floating on the surface.

examination of the deep-sea organisms obtained in the trawl and dredge, and with the larger animals procured at the surface. When, however, the expedition entered the tropics I frequently observed *Globigerinae*, *Orbulinae*, *Pulvinulinae*, and *Sphæroidinae* at the bottom of the glass globes into which the contents of the surface-nets were washed, and the attention of Wyville Thomson and the other

[1] Appendix to Dayman's Report, already cited.

naturalists was called to the fact. It was Wyville Thomson's opinion, however, that these shells really came from the deep-sea deposits. It was the custom to sift and wash large quantities of the ooze procured in the dredge on the deck of the ship, and it was believed that some of the shells from the deck being washed overboard were subsequently caught by the tow-nets dragging astern. But the appearance of the shells taken in the tow-nets was so different from that of those procured from the bottom that I could not accept the above explanation. When the weather permitted, the tow-nets were dragged, at considerable distances from the ship, from a rowing boat, and Foraminifera were procured in abundance. By using a water-glass I was sometimes able to dip up a single specimen in a glass beaker without in any way touching it. When this specimen was taken on board the ship, and placed under the microscope, the whole sarcode of the animal was to be seen expanded outside of the shell, as represented in Fig. 1. When our attention was once directed to the subject, the pelagic Foraminifera were observed in almost every haul of the tow-net. Many of the *Globigerinae*, the *Orbulinae*, and the *Hastigerinae* are furnished with long spines, and when the animal is expanded the sarcode rests between the spines. In the *Pulvinulinae*, the *Sphaeroidinae*, and *Pulleniae*, which have no spines, the shell is frequently so hidden in the expanded yellow-coloured sarcode that it may escape observation.

On the return of the *Challenger* Expedition, the late Mr H. B. Brady[1] and others pointed out that, if the *Globigerinae* were pelagic organisms, it was a most extraordinary circumstance that no naturalist had recorded them in any of the numerous tow-net gatherings about the British coasts. This, however, quite agreed with the experience of the *Challenger* naturalists. Whenever the ship entered a bay, an estuary, or, indeed, any coastal waters, the pelagic Foraminifera became very rare or entirely disappeared from the nets, although they may have been abundant fifty miles from the coast. I have never seen a single specimen in the tow-nets around the coasts of Scotland. In the *Triton* and *Knight Errant* Expeditions pelagic Foraminifera were found in abundance in the Gulf Stream waters which flow up the Faroe Channel, although not a single specimen was observed in the Minch or North Sea waters. The pelagic Foraminifera are truly oceanic creatures, even more so than the Pteropoda: they are most abundant in true oceanic currents; where these currents flow directly towards a coast they may be borne close to the shore, but usually they are only to be met with far out at sea.

From an examination of the large number of microscopic pre-

[1] *Quart. Journ. Micro. Sci.*, vol. xix., N.S., p. 292. 1879; see also *Zool. Chall. Exp.*, part xxii., pp. ix-xv. 1884.

parations and tow-net gatherings made during the *Challenger* Expedition, the following species of Foraminifera have been recognised as pelagic:—

Globigerina sacculifera, Brady.
" *aequilateralis*, Brady.
" *conglobata*, Brady.
" *dubia*, Egger.
" *rubra*, d'Orbigny.
" *bulloides*, d'Orbigny.
" *inflata*, d'Orbigny.
" *digitata*, Brady.
" *cretacea*, d'Orbigny.
" *dutertrei*, Brady.
" *pachyderma* (Ehrenberg).
" *marginata* (Reuss).
" *linnaeana* (d'Orbigny).
" *helicina*, d'Orbigny.
Orbulina universa, d'Orbigny.
Hastigerina pelagica (d'Orbigny).
Pullenia obliquiloculata, Parker and Jones.
Sphaeroidina dehiscens, Parker and Jones.
Candeina nitida, d'Orbigny.
Cymbalopora (*Tretomphalus*) *bulloides* (d'Orbigny).
Pulvinulina menardii (d'Orbigny).
" *tumida*, Brady.
" *canariensis* (d'Orbigny).
" *michelíniana* (d'Orbigny).
" *crassa* (d'Orbigny).
" *patagonica* (d'Orbigny).

Cymbalopora bulloides[1] (Fig. 3) can hardly be regarded as a true pelagic Foraminifer. It was only captured in the neighbourhood of coral reefs, and the curious thing about it is that not a single specimen was taken containing ordinary sarcode, similar to that observed in the other species of pelagic Foraminifera. In all the specimens the shells were filled with immense numbers of minute zoospores; these latter spread over the field of the microscope in a cloud-like swarm when a shell was broken under the cover-glass.

The usual colour of the sarcode of the pelagic Foraminifera is yellowish-brown. In *Hastigerina* it is bright red from the presence of red coloured oil-globules and pigment. This red colour enabled me to pick up this species with a beaker on the sea-surface more easily than other species. In *Globigerina bulloides* (*hirsuta*) and *aequilateralis* the yellow-orange colour of the sarcode is due to the presence of numerous oval-shaped xanthidiæ, or 'yellow cells,' similar to those found in the Radiolaria. When the sarcode with these 'yellow cells' flows out of the foramina, and mounts between the numerous spines outside the shell, the whole presents a very striking object under the microscope; the transparent sarcode can be seen running up and down the long silk-like spines, and the 'yellow cells,' seated at the base of these spines, quite obscure the body of the shell.

The majority of the species in the above list occur within the tropics, and the thick-shelled species occur only in warm water, such as *Sphaeroidina dehiscens*, *Pulvinulina menardii* (Fig. 4), *Pullenia obliquiloculata*, *Globigerina conglobata* and *sacculifera*. The number of species becomes less in the temperate regions, *Pulvinulina micheliniana* and *canariensis*, *Orbulina universa* (Fig. 2), *Globigerina bulloides* and *inflata* being the prevailing forms. In the Arctic and Antarctic

[1] See *Narr. Chall. Exp.*, vol. i., pp. 838-9, 1885.

regions *Globigerina dutertrei* and *pachyderma*, together with very minute specimens of *Globigerina bulloides*, appear to be the only forms present in the surface waters. The gradual disappearance of the tropical species, and their replacement by other species, as the colder water to the north and south of the equatorial regions is entered, has

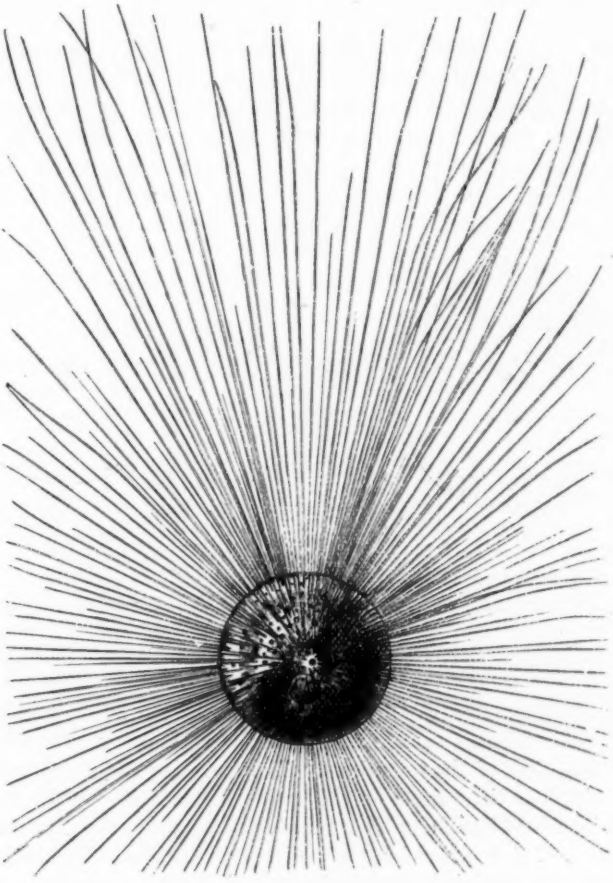


FIG. 2.—*Orbulina universa* (d'Orbigny), from the surface.

always appeared to me rather puzzling, especially when it is remembered that these changes take place in a continuous oceanic current, like the Gulf Stream, flowing from the equator towards the poles. It sometimes seemed as if the one form slowly passed into the other with the changed conditions of surface temperature.

The same species inhabit all the great oceans, but in the Indian and Pacific Oceans certain species appear to predominate, for

instance, *Pullenia obliquiloculata* and *Globigerina aequilateralis;* on the other hand, *Pulvinulina menardii* and *Globigerina rubra* appear to be more abundant in the tropical Atlantic.

The species inhabiting the north and south temperate regions, and the species inhabiting the two polar regions, appear to be nearly if not quite identical.

The distribution of the dead shells of the pelagic Foraminifera on the floor of the ocean corresponds exactly with the distribution of the living specimens at the surface of the sea. It has sometimes been urged that the dead shells of tropical species might be carried a long way to the north or to the south by oceanic currents, but this does not seem in any way to be the case; the distribution of the dead shells on the bottom does not appear to be much if any

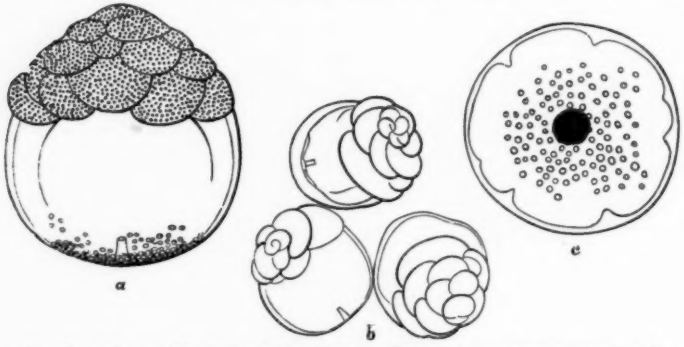


FIG. 3.—*Cymbalopora* (*Tretomphalus*) *bulloides* (d'Orbigny). *a*, large surface specimen; *b*, small (young) specimens from the same gathering; *c*, distal face of the balloon-like chamber, showing the entosolenian orifice, seated in a slight depression. All magnified 60 diam.

wider than that of the living specimens at the surface, and this shows that the dead shells must reach the bottom a very short time after the death of the organisms. The fact that the distribution of these shells at the bottom of the ocean is governed by the surface conditions is of itself almost conclusive proof that they live only at the surface, for otherwise their distribution would be similar to that of bottom-living, or benthos, species, which is wholly independent of the temperature conditions prevailing at the surface of the sea. Carpenter[1] and Brady[2] at one time held the view that young individuals lived at the surface and adult ones at the bottom; in addition to the fact that no living specimen has ever been obtained from the bottom, the above considerations with regard to distribution show that this view is not supported by any trustworthy observations. In the surface gatherings the young individuals are much

[1] *Op. cit.* [2] *Op. cit.*

more abundant than adult ones, still shells as heavy as any in the deposits are occasionally taken in the surface-nets. The young individuals are likewise more abundant at the surface than in the deposit, when compared with the adult shells present; this is especially the case in deposits from very deep water. This arises, as we shall see, from the more rapid solution of the young shells as they fall through the sea-water to the bottom.

When examining a deep-sea deposit it is always possible to say, from a study of the pelagic shells of the Foraminifera, whether the sample comes from the tropics, the temperate or the polar regions, but from the examination of these shells alone it would be extremely difficult to say whether the specimen was from the northern or southern hemisphere.

Off the Agulhas Bank at the Cape of Good Hope, off the east coasts of Australia and Japan, and off the east coasts of North and South America, oceanic currents from different sources meet and

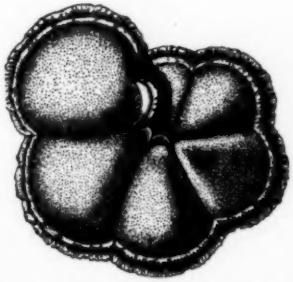


FIG. 4.—*Pulvinulina menardii* (d'Orbigny), from the tropical deposits.

mix, and there is a wide range of annual temperature at the surface. In these positions large numbers of pelagic Foraminifera (as well as other organisms) appear to be killed by the sudden changes of temperature, and consequently there are indications that the deposits, so far as due to these shells, are accumulating more rapidly in these areas than in other situations. It is a curious fact also that in these regions the deposits of glauconite and phosphatic nodules are more abundant than elsewhere.

In a certain sense the course of a surface oceanic current can be traced on the bottom by means of these dead pelagic shells; for instance, the axis of the Gulf Stream is marked out by deposits of Globigerina Ooze from the Strait of Florida to within the Arctic circle. No similar warm current enters the Antarctic region, and consequently no true Globigerina Ooze is found to the south of lat. 50° S. When the *Challenger* took her first deep-sea sounding after leaving Heard Island (in lat. 60° S.) there was much speculation as to what the nature of the deposit would be. I

ventured to say that it would not be a Globigerina Ooze, founding that opinion on the fact that only one or two small Foraminifera had been observed in the tow-nets for several days. When a white-coloured deposit was brought on board from 1260 fathoms the laugh was rather against 'the philosophers,' for in external appearance it greatly resembled the calcareous oozes of the Atlantic. On examination, however, it was found to be a Diatom Ooze with only relatively few *Globigerina* shells.

The most striking peculiarity in connection with the distribution of these dead shells on the floor of the ocean is the fact that they are wholly absent from all the greater depths of the ocean, although at the surface their living representatives are as abundant over these deep areas as elsewhere. If we suppose a volcanic cone to rise from the greater depths of the ocean up to within 400 or 300 fathoms of the surface, it will be found that the summit of this cone is covered with a calcareous deposit for the most part made up

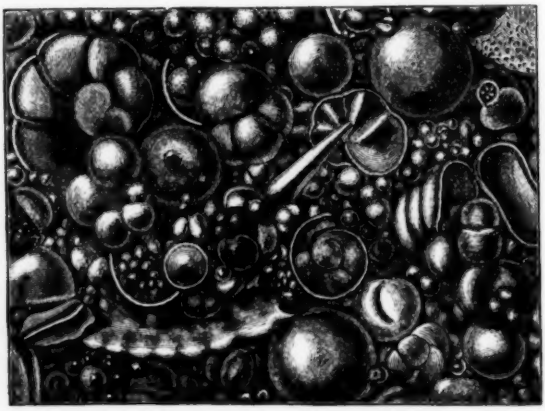


FIG. 5.—Globigerina Ooze, from 1900 fathoms in the Atlantic; magnified 25 diam.

of the dead shells of pelagic organisms, the deposit may contain 90 per cent. of carbonate of lime, and in it every species of shell met with in the surface waters of the region is represented. As we descend the sides of this cone into deeper water, the thinner and more delicate shells, like *Candeina* and *Hastigerina*, disappear first from the deposit (along with the Pteropod shells). In about 2000 fathoms the deposit consists chiefly of pelagic Foraminifera, and the proportion of young shells is much smaller than in the deposits at lesser depths. With increasing depth the whole of these calcareous shells gradually disappear, till at 4000 and 5000 fathoms probably not a vestige of them can be traced, and the deposit all round the cone in 3000 fathoms becomes a Red Clay

with only traces of carbonate of lime in its composition. Again, if we suppose a basin-like depression on the floor of the ocean, the centre of which descends to 4000 or 5000 fathoms, while the rim of the basin has only a depth of 1000 or 2000 fathoms, then, on the rim deposits of Pteropod and Globigerina Oozes will be found with 70 or 80 per cent. of carbonate of lime, while the centre of the basin will be occupied by a Red Clay with probably not a trace of these carbonate of lime shells. The gradual disappearance of these calcareous shells with increasing depth is evidently due to the solvent action of sea-water, and especially of deep-sea water. In the lesser depths a very large proportion of these surface shells seem to reach the bottom before they are completely dissolved, and accumulation takes place. With increasing depth the more delicate shells are dissolved before reaching the bottom, and accumulation becomes slower and slower, the last traces of these shells observed in the deposits with increasing depth being broken fragments of large *Pulvinulinae* and *Sphaeroidinae*. The greater quantity of lime in solution which Dittmar found in the *Challenger* samples of deep-sea water is apparently a consequence of the solution of the pelagic shells here referred to.

During the early part of the *Challenger* Expedition, Wyville Thomson was much puzzled to account for the origin of the fine Red Clay which occupies the basin-like depressions of the sea-bed far from land, and he suggested that this was an *ash*[1] left behind after the solution of the carbonate of lime shells. He was led to this view by observing that when the shells were taken from the purest samples of Globigerina Ooze, and, after being carefully washed with pure water, were dissolved with dilute acid, a small clayey residue of a red colour remained behind. I was not satisfied with this experiment, for I observed that the colour of the residue varied in different samples, and it seemed to me that the fine clayey matter had infiltrated the shells after they had reached the bottom. I accordingly collected, in the course of several months, about 10 grammes of pelagic Foraminifera from the surface of the sea. When these shells were dissolved in dilute acid not a vestige of residue was observed. It was subsequently shown that the Red Clay came from a variety of sources, and that in the deep sea far from continents it was chiefly derived from the trituration and decomposition of floating pumice.[2]

During the past year or two I have carefully collected all the available temperatures of the surface waters of the ocean, and from these have constructed a map showing the annual range of tempera-

[1] *Proc. Roy. Soc.*, vol. xxiii., p. 45. 1874.

[2] See Murray, *Proc. Roy. Soc. Edin.*, vol. ix., p. 247. 1876; also Murray and Renard, *Deep-Sea Deposits Chall. Exp.*, p. 294. 1891.

ture in different regions of the ocean. This map shows that the surface of the sea may be grouped into five great zones, viz. :—(1) A nearly continuous equatorial zone, where the temperature is high and the range throughout the year does not exceed 10° Fahrenheit. This zone includes all the principal coral-reef regions. (2 and 3) Two polar zones, where the temperature is low and the annual range likewise does not exceed 10° F. In these zones there are relatively few lime-secreting organisms. (4 and 5) Two regions lying between the equatorial zone and the two polar zones, where a wide range of temperature occurs between the different seasons (the annual range amounting to as much as 52° F. in some places). In these temperate regions the secretion of carbonate of lime appears to be much more active in the warmer than in the colder months. It thus appears that the most favourable conditions for lime-secreting organisms are met with in the warm, equable tropical waters of the ocean, and here as a matter of fact we find the greatest development of corals, and the largest number of lime-secreting pelagic organisms. In the polar areas and in the cold water of the deep sea there is, as is well known, a feeble development of all carbonate of lime structures in marine organisms.

From experiments which have been carried out by Mr Irvine and myself at the Granton Marine Station, we have reason to believe that this distribution is dependent primarily on the physical or temperature conditions of the oceanic waters. When carbonate of lime is precipitated by alkaline solutions, such as carbonate of soda, carbonate of ammonia, or carbonate of methylamine, the effect of temperature is very marked, and it appears to be the case that the secretion of carbonate of lime by organisms is of the nature of a fine precipitation in the interior of the soft structures.[1] If we add sufficient carbonate of ammonia to sea-water at different temperatures to convert all the lime salts present into carbonate, we obtain a precipitate which varies both in its crystalline form, in amount, and in time of formation. At 32° F. the precipitate begins to form in about six hours as small but distinct crystals of calcite, the quantity in twenty hours amounting only to 0·2 gramme from a litre of water. At a temperature of about 47° F. a mixture of calcite and aragonite is precipitated; at 80° to 90° F. the quantity precipitated is about 0·6 gramme, the precipitate begins to form in from a half to one hour, and it appears to consist of minute crystals of aragonite. It thus seems evident that carbonate of lime would be more easily and more rapidly secreted in the high temperatures of the tropics by means of the effete products of the organism.

As is well known, carbonate of lime in any form is easily soluble in water containing carbonic acid, and the aragonite form is more

[1] Murray and Irvine, *Proc. Roy. Soc. Edin.*, vol. xvii., pp. 79-109. 1890.

quickly soluble than the calcite form in the proportion of about three to two. Both aragonite and calcite are apparently very partially soluble in sea-water which does not contain free or loosely-combined carbonic acid, but when these dead shells are in contact with decaying organic matter, giving off carbonic acid, they are rapidly dissolved. An experiment with Globigerina Ooze in a sea-water containing additional carbonic acid showed that the thin walls of the chambers of the shells were first dissolved, leaving rings of the thicker portions of the *Pulvinulina* shells, for example. Decaying organic matter has a powerful solvent action on carbonate of lime, due to two causes: (1) by the carbonic acid formed as one of the products of this decay, and (2) on account of the formation of sulphides and sulphuretted hydrogen, due to the reduction of the sulphides present in sea-water.[1]

JOHN MURRAY.

[1] See Murray and Irvine, *op. cit.*, table on p. 106.

II.

A Californian Marine Biological Station.

THE European zoologist who visited the Pacific states would be very apt to find his way to the old Spanish-Californian town of Monterey, and to the Marine Laboratory of the Leland Stanford Junior University. As this station, however, seems to the present writer surprisingly little known in proportion to its deserts, a brief account of its equipment and surroundings may prove of interest to the readers of *Natural Science*.

This at the present time is the only permanent biological station on the American side of the Pacific. Temporary stations have indeed been established within recent years. The University of California has several times carried on a seaside school of zoology, both at Pacific Grove near Monterey, and on the Santa Catalina Islands in the region of Santa Barbara. Further northward, in Puget Sound, Washington, a local society, that of the Young Naturalists of Seattle, has done excellent faunal work during its camping seasons; and in the same region during last summer Columbia University of New York established a laboratory at Port Townsend.

The Stanford, or the Hopkins Laboratory, as it is called, is both an annexe and an integral part of its university. It was, indeed, contemplated as early as the time of the building of the university, when it was decided that a portion of the studies in zoology and botany might be carried on during the summer, the students to be given the regular credit for their work as in the winter courses. It was, accordingly, with a summer laboratory in view, that in 1891 two of the Stanford professors, Drs O. P. Jenkins and C. H. Gilbert, visited the region of Monterey (which had indeed been known to Dr Gilbert previously during his studies on the fishes of the Pacific), and made a reconnaissance to determine the particular point of the bay which was best suited to the needs of the collector and investigator. The site they then determined upon was at Pacific Grove, a few miles westward of Monterey. Here, in the first place were found most favourable fields for collecting. The shores were unshifting, the coast was rugged, while huge rock masses and bluffs alternated with sheltered harbours and beaches, rich in forms of animals and seaweed life. The locality seemed also a particularly convenient one on account of its facilities for the lodging and living

of students, a summer settlement of possibly five hundred people being in the immediate neighbourhood. It was here finally that land was obtained, a gift of the Pacific Grove Improvement Company, and the buildings were shortly put up and equipped, thanks to the generosity of Mr Timothy Hopkins, after whom the laboratory has been named.

The buildings are shown in the adjoining figure (Fig. 1), but

FIG. 1.—The Hopkins Seaside Laboratory, near Monterey, California. East view.*

the picture gives only a slight idea of their surroundings; thus they are seen to be built on a level field, and there is but a glimpse of the sea in the background. One needs, therefore, to imagine the laboratory site as a small treeless plateau, on the top of an abrupt rocky point which terminates about a hundred yards to the right in the picture. The sea surrounds the buildings, therefore, on three sides. In front there is a sheltered harbour and a small sandy beach, furnishing an admirable landing place for the boats; at the back the surf is breaking on the rocks thirty feet below—hardly far enough away as it has been proved, for in the winter storms the waves have threatened to overturn the buildings, and have rendered necessary the additional braces which one sees at the corners of the building. From its position the laboratory becomes a prominent feature of the entire neighbourhood. The visitor will not fail to notice it even at the incoming of his train, for he naturally will be looking seaward after his three hours' journey from San Francisco. He will just have passed through the hot and dusty valley country, but his interest revives as the train emerges on the sea-coast at Monterey, thence to skirt the shore of the bay during the few final minutes of the trip.

The bay of Monterey appears not unlike that of Naples. There is the same long curving beach, broken with rocky points, the clear

* The illustrations have been prepared by Mr Percy Buckman from photographs taken by the author.

blue water, and the same setting of half tropical vegetation, although the mountainous background is lacking. The climate is here less variable than at Naples; the temperature remains almost constant throughout the year, each day averaging about 60°F., and during six of the months outdoor life is not interrupted by rain. The railroad line terminates at Pacific Grove. Here on one side of the railroad are bluffs and the rocky point on which the laboratory is situated, while on the other a tidy little town, with well kept villas, bright shops, lines of tents for the summer campers, a good hotel, and a small park-like square, rich in the deep greens and light olives of Californian plants. All about are scattered forest trees—live oaks, tall pines, eucalyptus and palms. With these are numerous trees and hedges of the Monterey cypress (*C. macrocarpa*), whose very restricted range gives it an especial interest.

Point Aulon, the little promontory on which the laboratory is situated, juts out from the western end of the town. It has been

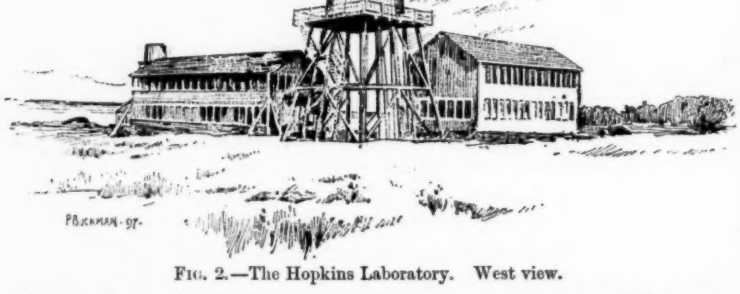


FIG. 2.—The Hopkins Laboratory. West view.

fenced off as a kind of marine park for the cottagers; and here at all times throughout the summer may be seen clusters of people, old and young, idling away their holidays, clambering about the rocks, or watching the ceaseless strings of cormorants, or the doings of the little school of boats huddled closely together off the point salmon catching, or the return of the little fleet of Chinese fishermen, whose curious town may be seen on a projecting coast point in the direction of Monterey. Such a thing as the sight of an occasional whale or sea-lion, and these will come surprisingly near the point, or even the loss of a straw hat, will cause a flutter of excitement among the summer visitors, diverting their attention, as a student will uncharitably believe, from their attempts to invade the penetralia of the laboratory.

Our second illustration (Fig. 2) gives a west view of the two buildings. The older, used during the first and second sessions of the summer school in 1892 and 1893, stands to the left, long, and

with many windows. It measures sixty feet long by twenty feet wide. The newer, smaller, but more substantial building measures forty by twenty-six feet. From the figure one may also see the two large salt-water tanks, which have been so arranged that each can supply either building. The older building is now used mainly for the classes of elementary students. It has two laboratories on the ground floor, a small engine room, and a concreted workshop, which serves as a dissecting room for the larger marine beasts. Upstairs a long laboratory faces the east, and on the south side a series of small separate rooms have been arranged for investigators. In the newer building a laboratory occupies the rear end of the ground floor, used during last summer mainly for students in the botanical courses; and on the floor just above there is a room of the same size, with blackboards, cases, and portable tables, used both as a lecture room and laboratory. The front part of the house in both storeys is divided by partitions into a dozen rooms for investigators, and it has, in addition, a photographic dark room. Throughout both buildings the fittings are simple but adequate. There is an abundant supply of microscopes, reagents, glassware and the usual set of dredges, tangles, and nets, a small beam-trawl, and apparatus for sounding and temperature-taking. At present the boat facilities include only a rowing boat and a small sailing boat, the latter almost too small for dredging or trawling, except in comparatively shallow water. Hitherto, however, the laboratory seems scarcely to have needed collecting facilities for the deeper water—enough at least to warrant the support of a steam vessel. The shore fauna has been of the richest, and dredging in shallow water could well be done with the boat at hand. As a convenient means of collecting in the shallow rocky bays a water-glass has been found of great service, especially in securing conspicuous forms such as echinoderms and holothurians, and has to a certain degree served as a substitute for diving apparatus, which here, as at the French marine station at Banyuls, might well prove of the greatest value. The station has never found difficulty in securing an abundant supply of fish material, thanks to the Chinese fishermen of the neighbouring village.

A whole article might be written on this small Chinese village near Monterey. It is but a quarter of an hour's walk from the laboratory, approached along the ledge of the railroad on the seaside rim of the town—a daily walk for a number of the students, who have come to have the greatest faith in the fishing powers of the heathen. This walk is by no means an uninteresting one; the sea-birds are around, whitening the tall rocky ledges, and on every hand there are quantities of little ground squirrels—a species of spermophile—which sit up before the visitor like little prairie dogs.

The village itself looks as though it has been imported from China in its present condition, a huddled little town of unpainted shanties sprinkled closely along a crowded street, with a few shops, a joss-house, and a sky-line of picturesque scaffolding for fish-drying. There will be a crowd of mushroom-hatted fishermen, a din of chaffering, a mixture of nets, trawl lines and baskets, distinctly unpleasant odours, placards of crimson and tinsel spattered with Chinese characters. The people are Cantonese, many of whom have been living here for two generations. They are classed as a peculiar poor grade of Chinaman, and are, I am told, looked upon at home as mere barbarians, if for no better reasons, that they have lived in China only two or three centuries, and are unable to trace their descent for more than seven generations. To the stranger, however, they certainly appear very industrious, honest (except in bargaining), kindly and painstaking. They are excellent fishermen, and in

FIG. 3.—The Chinese Fishing Village at Monterey. A corner of the beach.

several instances very intelligent collectors. Their little fleet of boats is often out before sunrise; between seven and ten they have become scattered along the coast, and their trawl lines are put out, often six or more (each about five-eighths of a mile long) to a boat; about noon-time they return, their skiffs sometimes gunwale-deep with fish-rock cod, black bass, flounders, mackerel, with an occasional wolf-fish,[1] their little latteen sails making the picture a still more foreign one. In a few moments after landing, the fish are carried off in shoulder baskets, to be shipped to San Francisco, and the boats are drawn high up on the beach (Fig. 3). The little colony also carries on a very successful squid-catching industry, so that at night there is often as much life and excitement in Chinatown as during the day. The amount of a catch will often be measured by tons.

[1] *Sebastodes* (*nebulosus*) and *melanops*, *Scomber* (*colias*), *Platichthys*, *Anarrhichthys*.

The boats go out with nets and red pine fires, which are hung cresset-wise over the sides of the boats to lure the squid. Some of these are intended to be cleaned and dried on latticed trays as a staple article of diet in Chinese markets. The bulk of the catch is, however, spread over the fields for drying, then to be packed in matting bags for export to China, as a rich fertilizer for the rice fields. Another phase of their industry is that of collecting abalones, *Haliotis*, these also to be dried for export. The people have their usual Oriental thrift,—they are infamous at a bargain, but make up this deficiency by the skill with which they separate the fertile or unfertile eggs of sharks or *Bdellostoma*, and recognise what they refer to as the 'hen' or 'rooster' sharks or rat-fish (*Chimaera*).

There is also another little imported village in this neighbourhood, nearer Monterey, namely, a settlement of Portuguese, who, like the Chinese, have retained minutely their foreign ways. Their boats are precisely those one would see in the Tagus, and, judging from the writer's experience in Portugal, he believes that the immigrants have not improved in the way of zoological collectors.

The laboratory has now completed its fifth season, and the work of last year seems to have been carried on very much in the lines of former years. There is a class in the dissection of types, and in the study of methods, limited to twenty or thirty students, each paying a stated fee for a term of six weeks. A second class includes advanced students in zoology, mainly from Palo Alto. The investigators, finally to be mentioned, occupy the private rooms in both buildings. These are afforded their quarters, reagents, and collecting facilities gratuitously. Class instruction is carried on by the professors of the Stanford University, during the present year by Doctors Jenkins, Shaw, and Wilbur. Among the investigators of the past summer were W. R. Shaw, working on the development of conifers, E. P. Wheeler, on the embryology of *Dicyema* and on diptera, D. A. Saunders, on the brown seaweeds, H. Heath, on the anatomy and development of *Chiton*, O. P. Jenkins, on contractility of muscles and conductivity of nerve-tissues in invertebrates, H. P. Johnson, on the annelids, and W. E. Ritter, on the ascidians, W. A. Setchell, on (laminarian) seaweeds, and the present writer, on the development of *Chimaera* and *Bdellostoma*. Many of these investigators have previously spent summers at the laboratory. Among the workers of former seasons might be mentioned H. Ayers, whose lecture on *Bdellostoma*, published in the volume of zoological lectures of Wood's Holl Laboratory (1893), has merited wide attention. Dr C. H. Gilbert, as the director of the station jointly with Dr Jenkins, has also been a constant visitor, and has here prepared no little part of his studies on the ichthyology of the Pacific. Dr E. C. Price, also one of the zoological staff at Palo Alto, was the

first of the several workers at the laboratory to secure embryos of *Bdellostoma;* while on the botanical side F. M. M'Farland and L. H. Campbell have been in frequent attendance. President Jordan has also taken the warmest personal interest in the work of the station, and although his researches have hardly been carried on at Pacific Grove, he has, nevertheless, been a constant visitor.

It is evident, perhaps, from the foregoing pages that the zoological station of the Stanford University has neither the equipment nor the subsidies of the Stazione at Naples, or even, as yet, of the laboratory at Wood's Holl; but the zoologist will certainly find there all of the facilities for his work which can reasonably be needed. The warm interest which Dr. Jenkins has shewn in the welfare of each worker of the station will not be forgotten; and it is doubtless due in no small degree to this care that the visitor

FIG. 4.—The Coast of the Pacific at Cypress Point, near Monterey.

takes away with him the kindliest recollections of Stanford's hospitality. The richness of the fauna and flora of this little nook in the Pacific cannot fail to leave the strongest impression upon the visitor's mind. He will remember the rugged shore line, with its stunted and twisted cypresses (Fig. 4), the sunken rocks bristling with the largest sea-urchins, the bright-coloured star-fishes, the orange-red *Cucumaria*, a yard in length. So too the tidal rocks covered with *Pollicipes*, the clumps of palm-tree-shaped *Postelsia*, the tangled masses of bull-kelp (*Nereocystis luteana*), whose stems are often many fathoms in length; the field-like areas of *Macrocystis* (*M. pyrifera*); the rich molluscan fauna, including the red shelled *Haliotis*, to be found even at the base of the laboratory rocks, *Cryptochiton* (*C. stelleri*) seven inches long, and abundant nudibranchs. There is a wealth of ascidians, annelids and hydroids. Nor does

this neighbourhood represent the vertebrates in a less interesting way. Mr Leverett M. Loomis, curator of the California Academy of Sciences, tells the writer that the coast line at Monterey is particularly prolific ornithologically; it includes among its common birds, cormorants, pelican, auklets, murres, and albatross. Among fishes there are several forms of especial interest. A species of *Chimaera* (*Hydrolagus colliei*) is plentiful in deeper water, twenty or more being a not unusual catch by a single boat. The hag-fish (*Bdellostoma stouti*) is one of the most common forms of the bay; and in some localities it is so abundant that it becomes a serious nuisance to the fishermen.

BASHFORD DEAN.

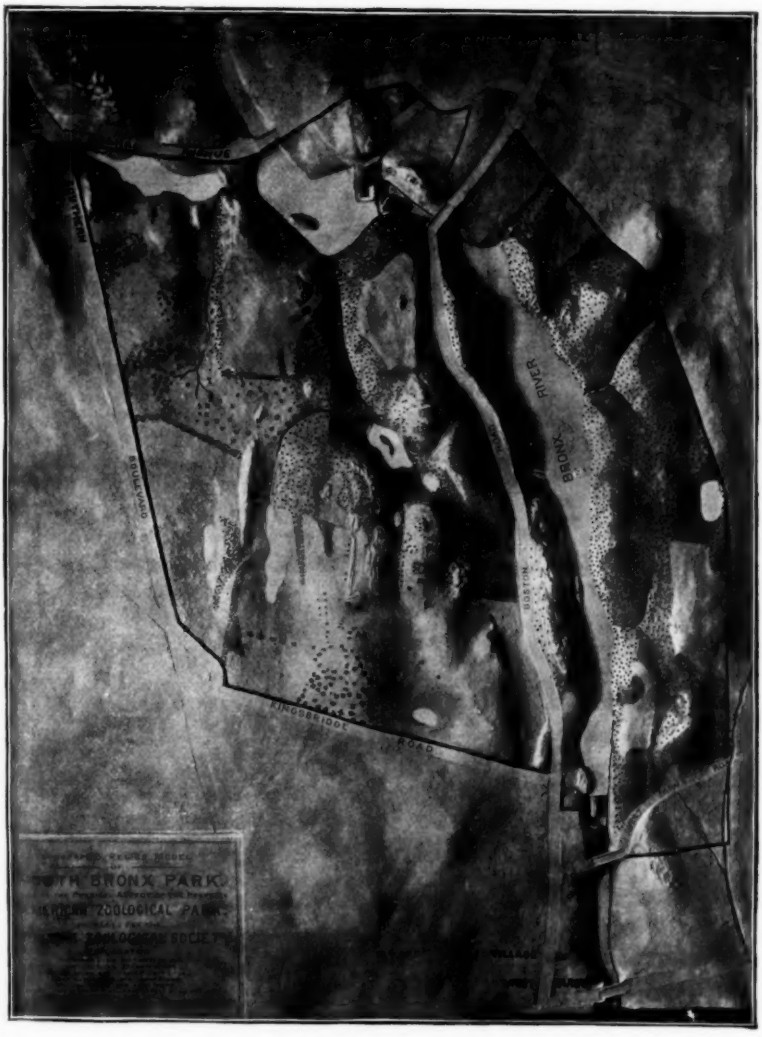
COLUMBIA UNIVERSITY, NEW YORK CITY,
April 1, 1897.

III

The Proposed Zoological Park of New York

IN the great city of New York, at the present time, the only place where living animals are kept for the edification and amusement of the public is what is called the 'Central Park Menagerie,' under the control, we believe, of the Commissioners of the Public Parks, which, though well kept and arranged, so far as it goes, is utterly unworthy of one of the largest cities in the world, which is adorned by so many and so various institutions. Several attempts have been made at different periods to start a zoological garden on a proper scale in New York, but it is only within the last few years that the subject has been taken up seriously, and in a manner which seems likely to produce definite results. So far, however, has the matter now progressed, that we have before us the first Annual Report of the New York Zoological Society, which received its charter in 1885, with the worthy objects of "establishing a free zoological park to contain collections of native and exotic animals," of "preserving the native animals" of the U.S. from further destruction, and generally of promoting the interests of zoological science.

Let us now see what the first Annual Report of the New York Zoological Society tells us about its progress and future prospects. Its Executive Committee appear to be mostly business men of New York, who are interested in the subject, but amongst them we note the name (as chairman) of Mr Henry F. Osborn, who is well known to all the scientific world as one of our leading authorities on mammals, and amongst the 'Scientific Council' we recognize the names of Prof. Allen, Mr F. M. Chapman, Dr T. H. Bean, and other gentlemen well known in scientific zoology. In Mr W. T. Hornaday the Council have made a choice as director for their Park, of another gentleman also well known in Europe, who possesses many excellent qualifications for the post. One of the first steps taken by the Committee—and a very wise one—was to send Mr Hornaday off to Europe for the purpose of inspecting and studying in detail the best zoological gardens of England and the Continent. Mr Hornaday's account of his tour of inspection, in the course of which he visited fifteen zoological gardens, will be read with interest, and we think we may say not without profit, by all those who wish



BIRD'S-EYE VIEW OF THE PROPOSED ZOOLOGICAL PARK AT NEW YORK

Photographed from the Society's Topographic Model

UNIV. OF MICH.

to make acquaintance with this subject. Five of the gardens visited, namely, those of London, Antwerp, Amsterdam, Hamburg and Berlin, are classed by Mr Hornaday as being of 'first rank,' and receive due praise for their success in various particulars. Warm thanks are also offered to the officials of these and the other gardens for the great help they have afforded to Mr Hornaday in his investigations. The principal criticism made upon these gardens by Mr Hornaday is that of want of space, many of them being so overcrowded with buildings and yards, that little attempt can be made to imitate the natural haunts of the creatures exhibited in them.

In European gardens, Mr Hornaday truly observes, "the large game—animals, such as the various species of deer, elk, bison, buffaloes, etc., are kept in small pens, because ample park-space is not available. Living trees are never utilized as homes for arboreal mammals. Ledges of natural rock are entirely absent, but hills of artificial rock, and small masses of stone, are quite common. With the exception of the great 'flying' cages of London, Rotterdam and Paris, the homes provided for birds are always of the most conventional and artificial character. The 'flying' cages, however, just mentioned are so very large, and contain so much of nature in the form of living trees, shrubs, plants and water, that the birds within them seem to be as much at home as if they were really in a state of nature, in a leafy wilderness."

We shall see presently that in the proposed new garden in New York, it has been wisely arranged that much more ample space shall be provided than is to be found in the existing establishments in the Old World.

Mr Hornaday also speaks of the attempts made in some of the European gardens to provide oriental buildings for oriental animals, and buildings of an elaborate architectural design. It is his opinion, and we quite agree with him, that conformity to a plain and uniform style of architecture is more desirable in such matters than a "succession of startling contrasts."

But although we have derived much instruction from Mr Hornaday's Report, and from the appositeness of some of his remarks, it is time now to turn to what our enterprising American friends propose to do in order to found in New York a Zoological Garden, certainly better provided with space, and, if possible, better ordered in every other respect than those of Europe. In selecting for the site of the proposed new garden South Bronx Park, a tract of "261 acres of forest, meadow-land, and water," in the northern environs of the city, in what is called the "annexed district," the Executive Council appear to have made a wise choice. As will be seen by the bird's-eye view of the surface of this piece of ground, taken from a relief model

of which by the kind favour of that Council we are enabled to give a copy herewith (Plate II.), the ground is sufficiently varied, well supplied with water, and provided with plenty of trees for shade. It also seems to be conveniently accessible by several lines of railway, electric and otherwise, although perhaps rather far distant from the great centres of New York population. But considering its large dimensions it could hardly be expected to be nearer. If, however, the proposed buildings are to be scattered about over so wide an area, it will become necessary, we think, ultimately, if not immediately, to provide some mode of locomotion from one building to another within the gardens.

The great extent of space available in South Bronx Park will of course be highly advantageous to the larger Ruminants, and we may expect that herds of deer, antelopes and other bovine animals will hereafter form one of its marked features. The manner in which the Executive Committee propose to deal with animals of this character will be seen by a second illustration which our friends have likewise provided for us (Plate III.), and which represents "Elk at sunrise, photographed from life." The following passages extracted from the Report inform us generally of the views of the Society regarding its proposed collection of living animals, in the wisdom of which we must all fully concur.

"As may fairly be expected, the first duty of the Society in the formation of collections, will be to bring together a liberal number of fine examples of the more noteworthy and interesting species of the animals of North America, particularly of those species that are threatened with extinction. No reasonable effort will be spared to show each species of the larger mammals under conditions of liberal space and surroundings which will at least suggest its natural haunts, which will promote the comfort and longevity of the captives, and render their contemplation by visitors a pleasure. Next to the mammals, birds and reptiles of North America, the fauna of South America will receive attention; but the Society's collections must of necessity include a sufficient number of the living creatures of the Old World to furnish the student and the general public with good examples of the principal orders, families and sub-families of the higher land-vertebrates of the world.

"It follows that, in the formation of the numerous living collections, which will find homes in the Zoological Park, the first to be gathered will be the representatives of the 'great game animals' of North America—the buffalo, elk, moose, mountain-sheep, antelope, black-tailed deer, Virginia deer, and caribou, and also the mountain goat, if it can be induced to survive in this climate. The enclosures planned for these species vary in area from three to twenty acres each. All will be abundantly provided with shade,

HERD OF ELK AT SUNRISE

Photographed from life at Adrian, Michigan

UNIV. OF MICH.

water and shelter, and such cliff-dwellers as the mountain-sheep will be located on rugged masses of natural rock. It is proposed that the buffalo herd shall contain about twenty-five carefully selected animals, living in a twenty-acre range, and be in every way worthy to represent this important species."

In conclusion, we are sure that all persons interested in Natural History will wish full success to the Zoological Society of New York, and will hope that the sum necessarily required to start such a large undertaking may be speedily raised. From the well-known munificence of the wealthy Americans in all matters of this sort it cannot be doubted that these expectations will be abundantly realised.

P. L. SCLATER.

IV

Primeval Refuse Heaps at Hastings

WHEN we reflect upon the abundance of refuse heaps left by early man on the eastern coast of the North Sea, as compared with similar accumulations on our own shores, we are tempted to seek a reason for the remarkable difference. In the former region these relics of man exist for many miles upon the shores as enormous heaps, hundreds of yards long and hundreds of feet in width, usually varying from three to six feet, but sometimes attaining as much as ten or twelve feet in thickness; while in England they are practically unknown.

There are several facts in connection with these old refuse piles which may assist us in our search for them in the British Isles. In the first place they are the relics of a people who lived upon fish, supplemented by such animal food as they were fortunate or clever enough to obtain. Darwin, in his "Journal" (p. 234), draws a picture of the shellfish-eating Tierra del Fuegians which, though a very dismal one, would doubtless equally well describe what might have been seen on the shores of the Baltic in the period under consideration:—"The inhabitants living chiefly upon shell-fish are obliged constantly to change their place of residence, but they return at intervals to the same spot, as is evident from the pile of old shells." Obviously, the refuse and rubbish of these people would be confined to the coast, for had they penetrated into mid-country their relics would necessarily be in the main of a different nature. It is also evident that the comparative stability of a coast line is essential to the existence of the "Kitchen-Middens"; and this idea is supported in Denmark itself, where these accumulations are found far more plentifully around the more permanent and protected fjords than upon the ever-varying seaboard. On the eastern side of England the cliffs have been wasting practically ever since the incursion of what we call the North Sea, and the breach by the Straits of Dover. It thus becomes obvious, that searching for these deposits in these or similarly circumstanced localities would be hopeless. If, on the other hand, we can get a firm unwasting coast line, furnished with convenient rock-ledges, which at once offer shelter while in use and immunity from destruction of deposits formed upon them, we have all the necessary conditions for the existence of Kitchen-Middens, and there they will doubtless be found all round the coast.

There is, however, no reason why the people who left these mounds of refuse should not have proceeded inland, and there formed settlements; but under these conditions the relics left behind would necessarily be of a very different nature. Certainly they would not consist largely of shells as does the Midden material near the sea-shore. If we found a similar set of animal remains in the Middens and in inland settlements, it would be something to indicate that both deposits might have been geologically contemporaneous. But this evidence would be by no means conclusive, as the people inland, in the absence of a plentiful supply of fish, might have been driven to the chase, and thus have captured a large number of animals which eluded the skill of the fisherman, remains of which would be present among the relics of the former but not among the latter. Then again, the landsmen would naturally be first to practise any kind of domestication of animals for the purpose of food and clothing, and would doubtless adopt this custom long before the fishermen annexed it to supplement their method of obtaining sustenance. It will thus be seen that, although a given set of animal remains might enable us to fix approximately the geological 'age' of the deposits, their presence or absence would not be sufficient evidence to enable us to correlate deposits found upon the sea-shore with those occurring mid-land. Unfortunately the appearance and disappearance of animals associated with man are not so clearly indicated by our time charts, as at present constructed, as they ought to be; so that the fossils of man's mental evolution over a given locality —namely, the exhibitions of skill in the production and fabrication of articles to obtain the necessaries of life, and make it more endurable, or gratify his desires—must serve as the figures upon our chronograph. If, for example, all implements found in these deposits were of the well-known Palæolithic types, we should not hesitate in classing the Middens as Pleistocene. If there were a profusion of beautifully polished axes and barbed arrow heads, we should assign them to the ordinary Neolithic men; and if only a single bronze implement were found, we should just as readily relegate them to the age of metal. So also if we find a certain set of relics differing from anything else previously recognised, although they may tell us little of the actual age of the deposit, yet they may prove invaluable in correlating the age of identical objects found over a large extent of country, and justify our assigning them to one race of people: and if from each of the localities in which these are found we obtain supplementary evidence, we may at last obtain a most comprehensive and reliable account of the heretofore unknown people.

Judged by this standard, I do not at present see anything to

connect the people who left the Hastings "Kitchen Middens" with those of the Baltic; still a great deal of work remains undone on both sides of the North Sea. The flora and fauna of the two countries are too dissimilar for exact comparison; but the implements in the two cases are practically quite unlike. Many of the habits of both peoples were, and are, the common property of all savages, or semi-savages, living under similar conditions; but beyond this I do not feel we can go safely, and I am therefore, from other evidence, disposed to regard the Hastings Midden men as quite a different race from those of the Baltic, and recognise their closer relationship with the race who made the identical curious little implements in the Valley of the Meuse and other places.

We will next take a survey of some of the features presented by the Hastings "Kitchen Middens," and note some of the points raised by them, and the contained materials. For fuller description of these on some points, to prevent repetition, the reader is referred to the paper in *The Journal of the Anthropological Institute*, vol. xxv., plates x.-xiii.

Hastings has always been celebrated for its picturesque rock-ledges, caves, and fissures, which exist on both sides of the old town; but few, if any, ever realize the antiquity of some of these, dating back as they do to the very earliest history of the weald, and will, doubtless, some day reveal to us our lost Miocene World. There can be no doubt that the celebrated St Clement's Caves or fissures originated in the great Earth movements above referred to: that they were inhabited in later Palæolithic times, and were enlarged by ambidextrous Stone Age man, and still more extensively excavated by right-handed Iron Age man, as shown by the pick marks still extant. I have found fragments of Neolithic pottery in them, and although much of their contents, dating back to the earlier occupations, may have been cleared away by Iron Age man, I still think they would well repay a thorough investigation. To what extent they were used by the Midden men it is difficult to say at present; but, so far as research has gone, it appears that the fissures nearer the sea were used more by way of shelter, and it is the rock-ledges outside these upon which the relics of the life of the time have been preserved. Plate V. shows the general appearance of these fissured and cavernous rocks; the accumulation of Midden material upon one of the ledges is seen in the front, as shown during the excavations. These projecting surfaces exist at all altitudes up to, say, 120 ft.; here were enacted all the dramas of domestic life, hither were brought the trophy of the chase, the captures from the sea, and the gatherings from the shore; to this resort were taken the pebbles from the beach, and here they were worked into the various forms and implements that man required for his increasing needs:

here he lit his fire, heated his pot or roasted the pony or deer he had captured in the chase; here he changed his broken flint tip snapped in the chase, replaced it by a new one, and threw the broken butt end upon the Midden. Here he also sat and split his marrow bones, and feasted right royally upon the contained luscious grease; and here he piled up his refuse heaps of everything with which he for the time being had done.

It is difficult to say which are the most interesting, the fauna of the period, the relics of which have been stored up in these old heaps, or the fossils of man's civilization in the form of flint and bone implements, pottery, etc. We will take the latter first, as belonging to the highest of the mammals represented.

THE WORKED FLINTS.

Being away from the chalk, the supply of flint had to be drawn from the pebbles on the sea shore. These were taken up to the settlement, and in several places heaps of these were found: they were sometimes 'quartered' when flat flakes were required, at others they were flaked into long narrow flakes, which required but little, if anything, done to them to make them fit for use. The almost absence of the ordinary more or less circular-edged skin-scraper—the commonest of all Neolithic implements—is very remarkable; but some spatulate forms were found, several of which were tanged for hafting. There were no large axes or adzes found, nor even the small triangular form, which exist in such profusion in the Danish Kitchen Middens, and no flint bore the slightest trace of polishing. One of the most remarkable and interesting features of the flints was the variety of forms of the chisels, gouges, and gravers, the cutting edges being always well worked, and either rounded or rectangular, turning now to the left and now to the right. A peculiar feature which strikes one in connection with these is, that they differ entirely from the majority of flint tools one sees in museums, in which is shown the expenditure of extensive trouble and work to bring the implement into an orthodox shape, although the cutting or operating edge is confined to an exceedingly small spot, and is entirely independent of the elaborate work of the other part of the implement. In these, on the other hand, it is just a simple flake, which is usually untouched, except at the point, where it is worked in a straight or oblique inward or outward curve or line; occasionally they are large, but not very often. With such a variety of carving tools in the possession of these old people, one is disposed to feel disappointed at finding so little evidence of the practice of carving. Still, it must be borne in mind that the Kitchen Middens after all were only waste heaps, and nothing of any value would be likely to be found in them, except an occa-

sionally lost article. That bone was largely used we shall presently see, and doubtless great care would be taken with these finely-carved articles, and they may be found when the innermost recesses of the fissures have been penetrated. That a large portion of flint flakes were intended for arrow and fish-spear tips is certain from the fact that many are secondarily worked into bilateral symmetry. Disregarding mere chips the long-pointed flakes monopolise 75 per cent. of the flints found; they vary in size from 4 in. by ¾ in. down to ½ in. and by ⅛ in. They were doubtless used for lance and arrow heads, fish-spears and fish-hooks; no sign of a barb of any kind was seen. A point of special interest in regard to these tips was that very many of them had well-worked butts, sometimes showing the removal of ten or a dozen small flakes in the formation of the well-rounded, nicely-bevelled, square or circular-ended base. There was one feature about these which puzzled me for a long time, and that was that the present periphery of the flake-face of the flint usually truncated these secondary flakings. It, therefore, became evident that the secondary base was worked round a single or double ridge while the lance-tip was yet upon the core, from which it was dislodged by the last skilful blow. In experimenting I found this practicable; and ultimately I found a block of flint worked into ridges in the process of manufacturing these tools in the way suggested, with one base worked ready for the next blow to produce a perfect implement. This specimen is shown in Plate VI., at the bottom right corner, and the arrow marks the point at which the last blow would have been struck, that would have dislodged the finished tip, such as is seen just at the left of it. That the tips were used and broken in the chase or in fishing is certain from the immense numbers of broken butt-ends that were found in the Midden; as it is only reasonable to suppose that, if these were broken in fishing or in hunting, the broken butts would have been taken off the line or shaft when the user returned to *chez lui* and thrown upon the refuse heap, and replaced by new ones. Large quantities were used as knives, and were hard worn.

The next most plentiful tool was the needle maker, or small hollow-scraper; these varied in size, say, from an inch or more, down to a tool that would turn out a bone duplicate of a good-sized thread needle.

There was an immense number of cooking stones indicative of the method of applying heat. Charcoal was fairly plentiful; and many of the bones of horse, pig, sheep, &c., were burned in the process of roasting upon the old hearths; the latter still remained in places. That the pots were put upon the fire, however, is certain from the fact that many had a deposit of soot upon them.

W. J. LEWIS ABBOTT.

(*To be continued next month, with the illustrations.*)

V

The Taxonomic Position of the Pteraspidae, Cephalaspidae, and Asterolepidae*

IN his notice of the life and work of the late Professor Cope, published in the June number of *Natural Science*, Mr Arthur Smith Woodward writes:—"It is mainly due to his initiative that we now regard the strange Pteraspidae, Cephalaspidae, and Asterolepidae (Ostracodermi or Ostracophori as Cope termed them) of the Upper Silurian and Devonian rocks as the armoured extinct allies of the modern lampreys (Marsipobranchii)."

No one, I am convinced, entertains a more sincere admiration for the palæontological work of Professor Cope than I do. His extraordinary insight (one might almost say 'instinct') in dealing with many problems of vertebrate morphology placed him in a very high position amongst modern comparative anatomists. But his genius was all the more astonishing owing to the fact that it was accompanied by equally extraordinary mental deficiencies—namely, a frequent failure of the power of correct conscious reasoning and a love of what Mr Smith Woodward calls "wild guesses" and other persons might term "baseless conclusions."

Mr Smith Woodward, in the passage quoted, cites with approval one of Cope's most empty taxonomic vagaries concerning the class of fishes; he solemnly states that it is due to Cope's "initiative" that "we" now regard the Ostracodermi as Marsipobranchii. Zoologists are of course aware of the fact that Mr Smith Woodward has given the weight of his reputation as an ichthyologist to this remarkable proposition. It seems to be a proper occasion, now that he tells us that there are others besides himself who have been impelled by Cope's initiative into so astonishing a point of view, to ask Mr Smith Woodward to state the reasons which induce him deliberately to assert that *Pteraspis* and *Cephalaspis* are armoured Marsipobranchii.

I think it will be generally admitted that it is not a sufficient justification for upholding such a taxonomic novelty as the one in question to point out that no one has shown any other position to

* For a general illustrated account of these extinct organisms see *Natural Science*, vol. i. (1892), pp. 596-602.

be the proper one for the doubtful group; we may not, for that reason alone, boldly assert that they are Marsipobranchs. Nor again will it be held to be sufficient in the opinion of most zoologists to say "Mr X. was a very gifted man, and he used to say that the so-and-so's are really such-and-such." It really is time for Mr Smith Woodward to give us more solid reasons than such as these for classing Ostracodermi with Marsipobranchii.

I shall be surprised if he can do so; for I have turned the matter over carefully and happen to have a rather intimate acquaintance with both the Ostracodermi and the Marsipobranchii. I am unable to find a single fact which can be considered as positive evidence of affinity between the two groups.

It is true that we do not know of the existence of paired fins in the Ostracodermi—nor in Marsipobranchii—but though the supposed pectorals of *Cephalaspis* are probably not to be regarded as pectorals, we are not in a position to assert that *Pteraspis* had no lateral fins, nor that the 'flippers' of *Pterichthys* do not represent such organs.

Before the proposition favoured by Mr Smith Woodward could be seriously discussed in the terms in which it is stated, it would be necessary to show that the Ostracodermi are a natural group, and no one can pretend that this is the case. The Cephalaspids, the Pteraspids, and the Pterichthyids were originally associated as 'Ostracodermi' for purposes of mere temporary convenience. It is a question whether in these days of an avowed genealogical implication in our classifications, such 'lumber-rooms' as 'Ostracodermi' are permissible. I think not. There is absolutely no reason for regarding *Cephalaspis* as allied to *Pteraspis* beyond that the two genera occur in the same rocks, and still less for concluding that either has any connection with *Pterichthys*.

If, in view of this fact, we consider in a more detailed way the suggestion of Cope, acclaimed by Smith Woodward, we find that it amounts to the assertion, that there are evidences of the close genetic relationship of the Marsipobranchii with *either* the Cephalaspids, *or* the Pteraspids, *or* the Pterichthyids—or possibly with all of them.

So far as I am aware the only satisfactory evidence of marsipobranch affinities which one could expect to be offered by fossil remains of palæozoic date, is the presence of a single median nasal aperture. The characteristic monorrhine structure of the marsipobranchs *might* have been recorded in the preserved remains of an armoured marsipobranch, had such a creature ever existed. Is there any evidence of such a single nostril in Pteraspids, or Cephalaspids, or Pterichthyids? Most assuredly there is not. There is no aperture in the cephalic shields of any of these forms which can be assigned to

the nostril. If these fishes possessed a nostril, single or double (as presumably they did), it seems that it was placed in such a position as to avoid perforating the bony shields of the head. To assume—in the total absence of evidence *pro* or *con*—that these fishes were monorrhine, is surely illegitimate and arbitrary. Further, there are in *Eukeraspis* and some other head-shields indications of lateral chambers, remotely suggesting lateral branchial chambers; but the form and position of these would be equally consistent with elasmobranch as with marsipobranch affinities.

It seems to me that even Huxley's cautious statement as to the affinities of *Pteraspis* and *Cephalaspis* goes too far. He says (*Quart. Journ. Geol. Soc.*, vol. xiv., p. 279), "A careful consideration of the facts, then, seems to me to prove only the necessity of suspending one's judgment." So far I entirely agree with him. He proceeds, "That *Cephalaspis* and *Pteraspis* are either ganoids or teleosteans appears certain, but to which of these orders they belong there is no evidence to show." That was written a long time ago. It seems to me that whilst there is abundant evidence to shew that Pteraspids and Cephalaspids, and also Pterichthyids were craniate vertebrates, there is nothing to show conclusively that they are referable to any known group of fishes, rather than that they are to be regarded as representatives of isolated extinct lines of descent. Their possession of paired orbits, fish-like scales, and fish-like median fins, renders it the course involving least assumption concerning matters of which we are ignorant, to treat them as detached groups of primitive fish-like forms, concerning the closer relationships of which judgment must be suspended.

The palaeontologist is, we must admit, entitled to make suggestions and guesses as to the affinities of the organisms which have left behind them the fragments with which he has to deal. On the other hand, if he aspires to be a zoological taxonomist he must accept the common point of view of zoologists. He does injury rather than benefit to zoological science when (as is, unfortunately, sometimes the case) he endeavours to impose an unwarranted "guess" upon zoological taxonomy as though it were a soberly worked-out conclusion, or reconstructs classifications hitherto based upon the consideration of comprehensive anatomical data, in order to give unnatural prominence to such characteristics alone as are furnished by the hard parts of organisms—parts with which a study of fossil forms renders him specially familiar.

E. RAY LANKESTER.

VI

Note on the Warm Undercurrent in the Arctic Ocean between Greenland and Spitzbergen

[In our review of Nansen's "Farthest North" (*Natural Science*, vol. x. p. 270, April 1897) we took occasion to remark that the author's recognition of comparatively warm water beneath the cold surface of the Arctic Ocean was no 'surprising' discovery, but merely confirmed "the observations of Scoresby, Markham, and Maury, and the views of Lyell, Croll, and other people not unknown." We now have the pleasure of further illustrating this point by publishing the following observations, with which we have been favoured by Mr Leigh Smith. They were written in 1875, but have not hitherto been printed.—EDIT. *Nat. Sci.*]

THE following table of deep-sea temperatures observed (with a Miller-Casella thermometer) on board the *Samson* in 1871-72, seems to me to establish Maury's theory of a warm undercurrent running into the Arctic Basin between Greenland and Spitzbergen. I cannot find an account of the temperatures taken by me on board the *Diana* in 1873, but they confirmed previous results.

TABLE OF DEEP-SEA TEMPERATURES TAKEN IN 1871-72 ON BOARD THE *SAMSON*.

Lat.	Long.	Surface temp.	Depth, fathoms.	Temp.
81°·20′	18°·0′E	33	300	42·5
80·10	6·55E	34·5	600	39
80·1	6·36E	34	50	37
,,	,,	,,	200	40
78·34	8·8 E	37	600*	33·5
77·16	4·38E	34·5	25	32
,,	,,	,,	250	39·5
76·36	2·14E	31	150	39·5
76·21	0·21E	36	150	39·5
76·20	0·21E	31	200	39·5
76·20	0·54E	33	50	40
,,	,,	,,	200	48·5
75·50	12·55E	40·5	100	34·5
,,	,,	,,	250	33·5
75·0	13·15E	41·5	100	34
,,	,,	,,	250	42·5
74·39	26·16E	32·5	30	34
,,	,,	,,	100	35·5
73·27	20·21E	38	100†	35
,,	,,	,,	230	44

* After this sounding was taken the thermometer ought to have been lowered to 250 fathoms, as it is probable that there might have been warm water that the thermometer passed through too quickly to register.

† South of Bear Island. Warm current going east.

This warm undercurrent, after passing Hakluyt's Headland, goes to the N.-E., and some of it may come to the surface in the shallow seas on the western shores of lands lying in that direction. This would account for the fact that Payer found open water and a warmer climate to the north.

Dr Carpenter, in a paper read at the Royal Institution of Great Britain on March 20, 1874, refers to his theory as "A general oceanic circulation sustained by a difference of temperature *alone*." In a paper read before the Royal Geographical Society, June 1, 1874, he also states his theory in the same terms. It is true that he afterwards admits that difference of salinity will produce a circulation, but then his theory simply becomes Maury's theory.

Independent of all theory the heaviest water will go to the bottom; therefore, if there is an oceanic circulation, whatever may be its cause, a warm stream of heavy salt water will flow beneath a cold stream of lighter brackish or fresh water.

Down the east coast of Greenland there is an Arctic current* about 200 miles broad, bearing on its surface a mighty floating glacier, which extends to Cape Farewell, a distance of 1400 miles. The rate of this current is variously estimated from 5 to 15 miles a day.†

How is the water and the salt so carried out of the Polar Basin replaced? Must it not be by an undercurrent of greater specific gravity running into the Polar Basin?

B. LEIGH SMITH.

* See Scoresby's "Arctic Regions," Drift of the Hansa.

† I am anxious to establish the existence of this current, as two great authorities have lately doubted it. I therefore append the following note, dated Feb. 16, 1897, from Mr R. Kinnes, manager of several whalers cruising during the summer season along the east coast of Greenland:—"The drift of the ice down the east coast of Greenland varies from 10 to 12 miles per day, and I think this may be taken as a fair average. If the wind is N.-E. it goes much faster, but with a S.-W. wind it travels eastwards. The pack may vary from 150 to 200 miles in breadth, according to the season. The current travels a little faster than the ice, and to the southward, near Cape Dan, it becomes stronger." I may also add that in 1874 Captain David Gray was up the east coast on the *Eclipse*, and he sent me the following extract from his log:—"July 24. Found by to-day's observations that we have driven 43 miles S. by W. ½ W. true in the past three days, and that in the face of fresh winds from S.-W."—B.L.S., May 1897.

VII

Karl Pearson on Evolution *

THE belief that the fundamental problems of organic evolution are essentially statistical problems, which require numerical treatment before they can be adequately solved, is constantly gaining ground; and with the growth of this belief the need for finer methods of statistical inquiry has grown also. With the exception of Mr Francis Galton, who worked for years almost alone in this direction, no one has done so much as Professor Pearson to make the systematic investigation of animal statistics possible. His development of the theory of Chance enables us now to find fairly simple mathematical expressions, by which masses of statistics, hitherto incapable of arrangement in such a form that the mind could grasp their meaning, may be easily and accurately represented. Professor Pearson devotes four of the essays in his recently-published volumes to a popular account of some of his results.

The first essay ("The Chances of Death") begins by showing how regularly "chance" is seen to operate, when a large series of fortuitous events can be observed. The regular character of such events, and the accuracy with which they can be predicted in the long run, is illustrated by records of experiments of the usual kind with coins, dice, and cards; and it is then shown that a law of the same form as that used to express the result of a long series of games of chance may be used to express, with the same degree of accuracy, the frequency with which given magnitudes of a cephalic index occur in a race of men, or the frequency of patients of given age among a large group of typhoid fever cases. Finally, the frequency of incidence of death at various ages among every thousand people born at the same time is exhibited as the resultant of five series of fortuitous events, each series producing its maximum death-rate at a particular period of life.

These examples are admirably fitted to show how such apparently irregular phenomena as death, or attacks of fever, or variation in the dimensions of a particular organ, may be easily and accurately represented so that the mind can grasp the effect upon the population as a whole, grouping the series of isolated instances

* The Chances of Death, and other Studies in Evolution. By Karl Pearson. 2 vols. 8vo, pp. xii. 388, and iv. 460. London: Edward Arnold, 1897. Price, 25s.

simply and naturally under one general law. The reader who is acquainted with the theory of Chance, as it is propounded in the ordinary text-books, will appreciate the great extension of the theory which is necessary in order to treat successfully such statistical results as those expressed by the remarkable "curve of infantile mortality," or even those relating to the incidence of scarlet fever, enteric fever, and diphtheria, at particular periods of life.

These illustrations being given in the first essay, the second is devoted to the results of roulette, as played at Monte Carlo, this being chosen as an example of results which are so little capable of prediction by the theory of Probability as to justify the belief that some constant influence other than chance is at work. The point of general interest is the smallness of the discrepancy between the observed result and that given by the theory of Chance which can be used as evidence of some constant disturbing factor.

The third essay, on "Reproductive Selection," contains a most interesting study of the importance to be ascribed to variation in fertility. The material used consists of two tables, showing the number of children arising from each of a large series of marriages. The first series contains 4390 marriages, which are spoken of as "Anglo-Saxon"; they are for the most part English and Americans of the well-to-do classes, with some from the Almanach de Gotha. The second series includes over 34,000 Danish marriages. The result is so important that a rough outline at least must be given. The following table shows the number of "Anglo-Saxon" marriages which produced any given number of children:—

No. of Children,	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
No. of Marriages,	546	656	682	628	496	383	336	228	172	118	63	47	22	8	2	1	2

The series contains no record of barren marriages; but for reasons fully discussed in the essay, 320 is assigned as the number of barren marriages likely to have existed in a population with the observed number of fertile unions. The above table may therefore be regarded as representing the offspring of 4710 marriages.

The total number of children produced is 19,833, giving an average of about four and a half per marriage; but the striking feature about the table is the demonstration that half of this entire number of children is produced by little more than a quarter (25·8 per cent.) of the total number of marriages, so that half the second generation are the offspring of a quarter of the first. Now, suppose this character of excessive fertility to be completely inherited, Professor Pearson shows that (in the absence of an enormous selective death-rate) ninety-nine per cent of the sixth generation would be descended from the "superfertile" quarter of the original generation. The effect of selection in checking this result among human beings

is examined, and the conclusion is reached that it is not sufficient to make any great difference—half the adolescent members of the second generation being produced by less than 29 per cent. of the first.

It is evident that any character, possessed by this original 29 per cent. of "superfertile" couples, will quickly spread among successive generations, unless it be extremely disadvantageous to its possessors; and as an example of the complicated problem presented by this result, it may be mentioned that Professor Pearson found, on examining 206 families, that the mean height of 133 men, fathers of less than five children each, was half an inch greater than the mean height of 73 men, each of whom was father of more than five children; but these 73 men produced between them 561 children, the 133 less fertile producing only 394 children. On the other hand, the more fertile mothers were sensibly taller than the less fertile. Perhaps no example could show more clearly than this the complex nature of the phenomena with which the student of animal evolution has to deal, and the absurdity of trying to deal with them otherwise than by the patient numerical evaluation of each factor separately.

The last essay to which attention can here be called is that on "Variation in Man and Woman." The object is to support the contention that women are on the whole more variable than men; and an immense series of measurements has been collected, in many of which—such, for example, as the cephalic index, the stature at particular ages, and others—this is undoubtedly the case. But it must be borne in mind that Professor Pearson refuses to consider "secondary sexual characters," and that he proposes a peculiar measure of variability. What exactly the rejection of secondary sexual characters means, it is difficult to understand; surely any character, other than the structure of the reproductive organs, may be called a secondary sexual character, if the two sexes differ with respect to it; and if this definition be adopted, Professor Pearson's position becomes unintelligible; if, on the other hand, the term be limited to those characters which are directly affected by sexual selection, then Professor Pearson should not permit himself to discuss the relative variability of a particular organ in men and in women without first showing that marriages occur at random so far as that organ is concerned. No definition of a secondary sexual character is offered in the essay, which is apparently directed against some rash persons who have asserted that every character is more variable in men than in women, and who attempt to deduce social and practical consequences from this proposition.

A more important point is the assumption "that the only useful sense in which we can study relative variability is by endeavouring

to answer the problem: Is one sex closer to its mean, more conservative to its type, than the other? and that the only scientific answer to this lies in the magnitude of the per centage variations of the two sexes for corresponding organs."

The meaning of this may be made clear by an example. Suppose a number of sticks, about a yard long, to be chosen by some rough process of measurement; and suppose that more careful examination showed the average length of these sticks to be 3 feet, while half the sticks were between 2 feet 11 inches and 3 feet 1 inch in length. Suppose, further, a second group of sticks, whose average length is 6 feet, while half the sticks lie between 5 feet 10 inches and 6 feet 2 inches. Now, since one inch is the same fraction of three feet that two inches is of six feet, Professor Pearson asserts that the only scientific view of the variability of the two sets of sticks is that which treats the two bundles as equally variable; and he accordingly defines the "coefficient of variation," or measure of variability, as the ratio of the "Standard Deviation" or "Error of Mean Square" to the Mean.

Now, it may at once be freely admitted that the coefficient of variation, as above defined, is an exact measure, and probably the best available measure, of the degree to which a group of animals is "close to its type"; that is to say, it is a measure of the extent and frequency of the mistakes a man would make, if he should simplify a discussion of these animals by using, instead of the individual animals, a series of perfectly average "types." It is precisely the measure of accuracy of the customary morphological definition of a species or variety. But the student of evolution may have to concern himself with another measure of variability, when he asks not "how close is the race to its type," but "how much material for Selection is afforded by the variability of the race?"

The functional importance of a variation of known magnitude, and the effect of such a variation upon the selective death-rate, seem legitimate, if difficult, subjects of scientific inquiry; and if it can be shown that an organ in one sex gives more scope for the selective formation of varieties or races than does the corresponding organ in the other sex, it is surely legitimate (neglecting the possible complications due to peculiarities of heredity) to say that one sex is more variable than the other. For example, it is certainly possible, in the case of the common fowl, to produce races of cocks which differ more from each other in the length of their tail-feathers than do any hens yet produced; and the statement, that the tail of cocks in general is more variable than the tail of hens in general seems thereby justified, whether the "coefficient of variation" in the cocks of any one race be greater than that of the corresponding hens or not.

No one acquainted with the facts of animal variation—certainly not Professor Pearson himself—will assert that the "coefficient of variation" is always a measure of the importance of variations; no one will believe that in any animal a deviation of ten per cent. in excess of the mean of one organ has of necessity the same importance as a deviation of ten per cent. in excess of the mean in another organ. A finger nail of double the normal length, or a hair of double the normal thickness, will hardly produce so much inconvenience as a leg of double the normal length. It is even certain that in closely allied species the same per centage deviation of corresponding characters may produce widely different effects.

There is no doubt that the "coefficient of variation" is for certain purposes a valuable measure of variability; and Professor Pearson has shown, in some of his more technical papers, that it is of great use in establishing important propositions in the theory of Chance. At the same time, students of evolution, paying attention specially to the functional importance of variation, may need units proportional to this importance; and such units may well be different in different cases. The violent assertion that there is only one "scientific" measure of variability is therefore to be regretted.

Whether one agrees with Professor Pearson on this single question or not, one cannot but be grateful to him for the four essays here referred to, as well as for the more elaborate memoirs on which they are based. The picture they present of the orderly treatment to which animal statistics can be subjected, so that hitherto unwieldy and perplexing masses of figures can be made to yield simple and intelligible results, should do much to make the study of Probability, in its application to the problems of animal evolution, more popular than it is, and to enable biologists at last to put before themselves an adequate numerical estimate of those phenomena which it is the business of their lives to formulate and to explain.

W. F. R. WELDON.

SOME NEW BOOKS

Our Dead Volcanoes

The Ancient Volcanoes of Great Britain. By Sir Archibald Geikie, F.R.S. 8vo. 2 vols., pp. xxiv. and 478, and pp. xvi. and 492. With 7 folding maps and 383 illustrations. London: Macmillan & Co., 1897. Price, 36s net.

This work is an expansion of the two addresses given by its author to the Geological Society of London in 1891 and 1892. Those of us who have often marvelled at the amount of detail, largely new, that was brought into the compass of the addresses, may have foreseen the solid and permanent character of the two large volumes now before us. In earlier years, Sir Archibald Geikie spent his leisure in volcanic areas—travelling, observing, correlating, and storing up the wealth of information which is now made orderly and accessible. The 270 pages—more than a quarter of the whole work—devoted to the Devonian, Carboniferous, and Permian volcanoes of Scotland will be welcomed on these historic grounds. And in later years, with the resources of the Geological Survey at his command, the author has been able to extend his area, so as to examine the whole range of volcanic phenomena in our islands. Ireland is not mentioned in the strict title of the work, but is in reality dealt with in a manner that atones for a great many omissions on the part of British text-books. We have here, in fact, a basis which must be consulted before work is begun on any igneous rocks of the British Isles, for Sir Archibald frequently, and very properly, treats of holocrystalline and deep-seated masses in addition to the volcanic relics associated with them.

So far as we can judge, the passages compiled from previous writers have been drawn up with admirable accuracy, even to the use of the rock-names employed in the original papers. These names, in fact, would sometimes be the better for a little comment or revision, as in the case of the French rock-term 'labradorite,' imported on p. 29. The book is, however, written for geologists, and largely for those engaged in actual investigation; it has, at any rate, the merit of offering no encouragement to young persons 'reading' for examinations.

While book i. is of a general character, there is much in it that is admirable and suggestive to the worker in the field. We may note, for instance, the diagram of "the gradual emergence of buried volcanic cones through the influence of prolonged denudation" (p. 75). The characteristic structures of igneous rocks are described, and are illustrated by photographs from actual specimens. The polished surface of 'Napoleonite' on p. 22, and the fluidal Antrim rhyolite on p. 23, are perfect examples of their kind.

It is surely, however, an undue extension of terms to call the structure of 'Napoleonite' variolitic; and we could wish that variolitic and orbicular structure had not been separated from spherulitic in the text. The ophitic structure, again, is referred to, as in so many

works, from its superficial or microscopic aspect, the enveloping crystals of pyroxene being described as 'large plates.' As all field-workers know, they are often so uniform in length, breadth, and thickness, as to produce the appearance of nodules on the weathered surfaces of a rock.

In dealing with columnar structure, it is remarked that in one type, of which the rock at Fingal's Cave is an example, "the columns pass with regularity and parallelism from the top to the bottom of a bed." The other type is of the irregular character. "At Staffa the regularly columnar bed is immediately overlain with one of the starch-like character." Though we are told that the two types may even pass into one another, we should have liked an opinion as to their continuity in the case of Staffa. In vol. ii., p. 210, the photograph of that island is used to show the 'bedded' structure of the basalt; and the reader might easily regard the mass as formed of two successive sheets. Some reference would be useful to Scrope's observations in

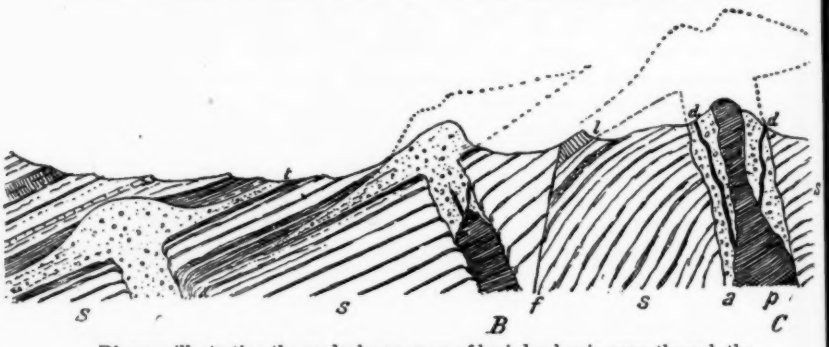


Diagram illustrating the gradual emergence of buried volcanic cones through the influence of prolonged denudation.

the Vivarais ("Considerations on Volcanoes," 1825, p. 141), already noticed in Prof. Judd's 'Volcanoes.'

Another case in which the opinion of Sir Archibald Geikie would have been of service is in regard to the relation of laccolites to earth-movement. How far does the pressure that propels the lava forward enable it to lift up the dome of strata and to form a cistern for itself? In any case, we are not left with the vague idea that some expansive force within the molten mass itself enables it to upheave the earth above it (p. 87, and vol. ii. p. 361); but might not greater emphasis have been laid upon the view stated on p. 98, where the cavities occupied by the lava are themselves referred to earth-movement? Mr Gilbert, however, was undoubtedly of opinion in 1877 that the pressure on the fluid mass was sufficient to produce the arching above the laccolite.

A good summary of the theory of differentiation in plutonic masses, and of recent results on 'bosses,' is given on pp. 88-99. The variation of an intrusive magma by absorption of surrounding rocks is also very fairly dealt with.

Chapter vii. gives scope for some of those admirable descriptions of landscape, which recur afterwards delightfully through the work, and which constantly remind us of the open-air culture of the author.

Page after page attests the energetic field-work on which each series of results is based, though now and then acquaintance with the ground is required, before we can detect how much is due to a grasp of the features of the scene itself, and how much is culled from the drier field of published memoirs.

We must not attempt, chapter by chapter, to touch on the numerous new suggestions, or the revisions of previous work, contained in the description of each special area. On p. 145, we note that the Cambrian is stated to pass down conformably into the Pebidian of St David's, which is included with it, the Arvonian and Dimetian being intrusive; and no pre-Cambrian rocks are tolerated here. But in other places the earlier work of the survey is candidly set aside, where the personal investigation of the author has led to a change of view. Here and there, work remaining to be done is indicated, as in the Malvern range (p. 170), and in the important Borrowdale series (p. 227).

In the latter case, the discussion given in the present work does much to fill the gap, and is a fine example of the caution with which such altered masses must now-a-days be approached. We have done with the broad structural diagrams, accompanied by 'theories of the earth,' which had to serve as a basis for future observations, at a time when the labourers were few; and Sir Archibald Geikie writes of the map of the lake district, "so rapid has the progress of certain branches of geology been since these sheets were published, that the map is even now susceptible of considerable improvement."

A strikingly new chapter, embodying results hitherto unpublished, or, perhaps, only hinted at in the annual reports of the Geological Survey, deals with "the Silurian Volcanoes of Ireland" (pp. 239-256). We note than an Arenig age is suggested for the crushed tuffs of eastern Tyrone, formerly regarded as 'Dalradian'; but "no recognisable radiolaria have yet been detected" in the associated cherts.

An interesting point in the description of the Old Red Sandstone eruptions is the occurrence of infillings of sandstone in the cavernous hollows of lavas poured out under water (pp. 283 and 333). In some cases, these sandstones are even stratified, reminding one of the material deposited in the interstices of a coral-reef.

We are glad to note, on p. 346, the decided attitude taken up with regard to the correlation of the Dingle Beds. Irish geologists have, more or less, played with this important stratified series, usually referring it to the Silurian, although it clearly caps the Ludlow beds. Since Jukes led an attack upon the Devonian system as a whole, an attempt has been made to do without that system in Ireland, the Upper Old Red Sandstone being carried bodily up into the Carboniferous, and the lower thrust down into the Silurian. No man living can speak with better authority on this point than Sir Archibald Geikie.

The first volume closes with a superb series of full-page photographs of the Carboniferous volcanic phenomena of Scotland. While these recall the work done by the Geological Survey of the United States, we can only regret that in our own islands their publication, on this ample scale, has been reserved for private enterprise. We cannot resist mentioning by name the view of the agglomerate of the Binn of Burntisland (p. 431), which equals the fine Cainozoic sections

in the neighbourhood of Budapest, and the spheroidal weathering of dolerite at North Queensferry, given on p. 455.

The second volume opens with the Great Whin Sill, which is provisionally referred to the Carboniferous period. A considerable series of volcanoes is then included as Permian, or possibly Triassic, on the ground that "there is usually ample proof that the strata in question [associated with them] are much later than the Coal-measures, while their geological position and lithological characters link them with the undoubted Permian series of the north-east of England." The best known mass placed in this group is the upper portion of Arthur's Seat, Edinburgh, which, the author maintains, is independent of the older and true Carboniferous series. He thus supports Maclaren's view of 1839, in opposition to its subsequent revision by its author, and to the well-known paper by Prof. Judd.

Some exceedingly pretty mapping of the fragmental materials in a vent at Elie Harbour, Fife, is seen in Fig. 217; and the volcanic sections of this district are again finely illustrated by full-page photographs. The capping of Titterstone Clee, in Shropshire, is referred also to the Permian period.

Then comes the great gap in our volcanic history, book viii. opening with Cainozoic times. The plateau-basalts are attributed to fissure-eruptions rather than to repeated flows from central vents; and a very valuable chapter (pp. 260-269) supplies an account of such eruptions in recent times in Iceland. It is, however, pointed out that the tabular sheets are composed of the union of successive flows, one overlapping on the edges of another (p. 193); and the fact that cones are formed along the lines of fissure, each sending out its separate flows, is clearly brought out on pp. 264 and 265. The absence of clear evidence of the connexion between our dykes and the superficial flows is very candidly stated (p. 268). The recognisable vents, such as Slemish in Antrim, and other well-known necks in the same county, indicate more normal conditions of eruption.

While there is this difficulty in correlating the intrusive basalts with the lavas penetrated by them, we must also face the similar difficulty arising from the lack of continuity between the gabbro masses of Mull and Skye and the surrounding plateau-basalts. If the dykes form the orifices for the extrusion of the latter, why may not the heart of Skye have served equally as a great volcanic centre? In both cases, the intrusive rock presented to us is that which last consolidated in the vent; its earlier and basal volcanic products may, however, remain to us in the surrounding lavas. Surely the great core of Vesuvius is at this moment intrusive in the earlier lavas of its flanks. The author recognises some such argument on p. 348, but will not allow the site of the Cuillin Hills to have any direct relation to the existing surface-products (p. 362). Granting that a number of small vents suits the conditions recognised in Antrim, why may we not have traces of more centralised activity in Mull and Skye? The difference of opinion between the author and Prof. Judd on this point appears less fundamental, less to be insisted on, the more clearly we have laid before us the relations of the dykes and plateau-basalts from the fissure-eruption point of view.

It can hardly be expected that Ireland should receive more detailed

SGUIR NA GILLEAN, SKYE, SHOWING THE CHARACTERISTIC FORMS OF WEATHERED GABBRO

UNIV. OF MICH.

treatment, in regard to its Cainozoic volcanic areas, than is accorded to it in the present volume, which is far and away more generous than any predecessor. While Ireland cannot at any point equal the crags of Scuir na Gillean (p. 335), so finely set forth by Mr Abraham, yet we should have liked some recognition of the strikingly scenic aspect of the Mournes, one of the most 'self-contained' and solitary mountain-groups in the British Isles. One page deals with this district, while as many as seven are devoted to the Limerick Basin, fourteen to the toadstones of Derbyshire, and thirteen to St Kilda. To ask for more, however, when we close these handsome volumes, is only a well-merited compliment to their author. G. A. J. COLE.

A LIVE NATURALIST

ROUND THE YEAR: A SERIES OF SHORT NATURE STUDIES. By Professor L. C. Miall. 8vo, pp. viii., 296. With illustrations chiefly by A. R. Hammond. London: Macmillan & Co. 1896. Price, 5s.

"LIVE Natural History!" The phrase is our author's, and no better example of it could be found than this book. It is, we may imagine, just such a book as might have been written by Gilbert White had he lived in these days, and had the benefit of a thorough scientific training. Against the 'dry, marrowless, useless,' 'melancholy' and 'stodgy' catalogue-type of natural history, the author raises a just protest. There is also a style of natural history writing that consists largely of phrases without knowledge and imagination unallied to observation. Professor Miall gives us the attempted literary charm of the latter with the accuracy and wealth of knowledge of the former. He takes us out into the fields and over the mountains, but does not forget that there is a well-stocked library at home. It is indeed a feature that we would fain see more of in so-called popular 'Natural Histories'—this constant reference to fuller accounts and original authorities. So many writers treat their readers as sheer dyspeptics, unable to digest aught beyond pap.

As examples of the subjects so fascinatingly and suggestively dealt with, we may mention: snow-flakes, birds in mid-winter, cat and dog, the moon, spring crocuses, catkins, the oil-beetle, the botany of a railway station, hay-time, cabbages and turnips, weeds, the love of mountains, the reversed spiral, the structure of a feather, the shortest day of the year.

It is now July, and we find our author treating of duckweed. How many of us know its flower? Now is the time to see it. Let the field naturalist take some duckweed from the water, and, with Professor Miall, let him examine, describe, and draw it. The reasons for its peculiar shape may then be guessed at, and the guesses checked by experiments with models. Thus he is led to understand more about the relations of this common water-plant to its environment, and the ways in which it may spread from one pool to another. How widespread it is he must learn from books, such as Hegelmaier's "Die Lemnaceen."

A word of praise is due to the illustrations, the fresh pen-and-ink drawings by Mr Hammond being specially clear and artistic.

SCRAPS FROM SERIALS.

THE June number of the *Westminster Review* contains the conclusion of an article by J. F. Hewitt on the cave deposits of the Ardennes, which he thinks contain evidence to show that the palaeolithic dwellers in those caves had a regular totemistic system.

There is no magazine in New Zealand, but the *Press* of Christchurch attempts to supply the want by publishing, every Monday, signed articles on literary, social, and philosophical questions. The issue for April 26 contains an interesting account by Prof. Arthur Dendy of the land-planarians, nemertines, and the *Peripatus* of New Zealand.

The Photogram is publishing a useful series of articles on applied photography. Application No. 5, which appears in the June number is 'in Zoology,' by Dr R. W. Shufeldt, and is illustrated by some admirable examples. A cognate subject is "Stalking with the Camera," by R. B. Lodge, of which part 3 appeared in the May number. This appears to be quite as exciting as stalking with a gun, and the results are both permanent and valuable.

Geologists who propose attending the International Geological Congress, and who may be so fortunate as to have obtained tickets for the excursion to the Caucasus, should study a sketch of the geology of that region, published by V. Dingelstedt in the *Nauchnoe Obozryenie*. Or in case this is beyond them, they will find an excellent summary in the May number of the *Scottish Geographical Magazine*.

The *Journal of School Geography*, edited by R. E. Dodge, New York, maintains its bright and useful character. The April number contains a short article on the geographical distribution of plants, by Prof. Conway Macmillan, who contends that the study of plant distribution in a limited area, such as a pond and its shores, or a hill and its slopes, would be of more value in schools than 'the ordinary herbalism.'

In the numbers of the *Revue Générale de Botanique* for the present year some useful reviews of recent work done in certain departments of the science are in progress. One by A. Prunet deals with results in plant anatomy, published in the years 1892 to 1894. The first four numbers treat of the anatomy of the cell under the headings of *Nucleus*, *Eléments figurés* (including Crato's *physode*, and certain chlorolenciles), and *Membrane*. The review is illustrated, and references are given to original papers. The second, by Géneau de Lamarlière, relates to descriptive work on mosses, published between January 1889 and January 1895.

NEW SERIALS

THE *Revista Italiana di Sociologia*, Rome, intends to be a thoroughly scientific and independent review. Since it numbers among its editors such men as Salvatore Cognetti de Martiis, Augusto Bosco, G. Cavaglieri, G. Sergi, V. Tangorra, and Enrico Tedeschi, it is probable that the promise will be fulfilled.

We have received No. 2 of the *Aeronautical Journal*, which to non-members costs 2s., though it contains only 20 pages. It is thoroughly practical, and brings together all that is taking place in the aero-

nautical world, whether in the form of experiments, lectures, publications, magazine articles, inventions, or patents.

La Revista Nueva is an illustrated monthly, which commenced publication at San José, Costa Rica, in September 1896. The directors are R. Fernández Guardia and Alberto Masterrer, and they have the moral support of the Government. The price is 60 cents a number, 1 dol. 50 cents a quarter. For the most part the *Revista* is devoted to general and literary topics; but we notice that the earlier numbers contain a series of articles by Anastasio Alfaro on the antiquities and the mammals of Costa Rica. Among the coloured plates are representations of figured jars in the museum of Costa Rica.

We have received the first two fascicules of *Revista Quindicinale di Psicologia, Psichiatria, Neuropatologia ad uso dei Medici e dei Giuristi*, which is the expressive though cumbersome title of a fortnightly magazine, blessed with two directors, seven editors, and twenty-nine collaborators. The chief editor is Dr Sante de Sanctis, R. Clinica Psichiatrica, Via Penitenzieri, 13, Rome. The publishers are Fratelli Capaccini, Via Sistina 22, Rome. Each fascicule, which consists of 16 pages, contains two original articles and several reviews. A year's subscription (from May 1 in each year) is 6 lire. The *Revista* should do much to produce healthy co-operation in Italy between the students of pure psychology and their fellow-workers in criminal and pathological psychology; success seems guaranteed by the eminence of the contributors.

Further Literature Received.

First Stage Mechanics of Fluids, G. H. Bryan and F. Rosenberg. First Stage Sound. Light and Heat, J. Don: Clive. Text-book of Geology, W. J. Harrison: Blackie. Hand-book to the Order Lepidoptera, W. F. Kirby: Allen. Catalogue of the Fossil Cephalopoda in the British Museum, Part III., A. H. Foord and G. C. Crick. Catalogue of Tertiary Mollusca in the British Museum, Part I., G. F. Harris: Trustees Brit. Mus. The Concise Knowledge Natural History, ed. by P. Myles: Hutchinson. Field Geology in South Westmoreland, H. G. Foster-Barham: Atkinson, Kendal. Investigations into Applied Nature, W. Wilson: Simpkin, Marshall. The Aeronautical Annual, 1897: Wesley. The Psychology of the Emotions, Th. Ribot: Scott. Annual Report of the Geological Survey of the United Kingdom, 1896, A. Geikie: Science and Art Dept. Memoirs of the Field Columbian Museum, Chicago, Vol. I., No 2, Ornithological Series, No. 3, Botanical Series. Farmers' Bulletin, No. 4: U.S. Dept. Agriculture.

Poissons provenant des campagnes du yacht l'Hirondelle (1885-88), R. Collett. On the Origin of the European Fauna, R. F. Scharff: *Proc. Roy. Irish Acad.* On the Brains of two Sub-Fossil Malagasy Lemuroids, C. J. F. Major: *Abstr. Roy. Soc.* On Nereids commensal with Hermit Crabs, N. R. Harrington: *Trans. New York Acad. Sci.* Edward D. Cope, H. F. Osborn: *Science.* Comparison of the Carboniferous and Permian Formations of Nebraska and Kansas, C. S. Prosser: *Journ. Geol.* Some Observations on certain Species of *Arion*, W. E. Collinge: *Journ. Malacol.* On Ctenoplana, A. Willey: *Quart. Journ. Micro. Sci.*

Jersey Times, June 7; Tunbridge Wells Gazette, May 26; Amer. Geol., June; Amer. Journ. Sci., June; Amer. Nat., June; l'Anthropologie, March-April; Botan. Gazette, May; Feuille des jeunes Nat., June; Irish Nat., June; Knowledge, June; Literary Digest, May 15, 22, 29, June 5; Naturae Novit., May; La Naturaleza (Madrid), May 14, 28, June 8; Naturalist, June; Nature, June 3, 10, 17; Naturen, May; Photogram, June; Review of Reviews, May, June; Revue Scient., May 22, 29, June 12; Science, May 14, 28, June 4; Scient. Amer., May 15, 22, 29, June 5; Scot. Geogr. Mag., June; Scot. Med. and Surg. Journ., June; Victorian Nat., May; Proc. Biol. Soc. Washington, Vol. XI., May 13; Chivers' New Book List, June; Halifax Naturalist, Vol. II. No. 8, June; Journ. School Geogr., May.

OBITUARIES

AUGUSTUS WOLLASTON FRANKS

BORN 1826. DIED MAY 21, 1897

SIR AUGUSTUS WOLLASTON FRANKS, K.C.B., D.C.L., F.R.S., Pres. S.A., F.G.S., Trustee of the British Museum, late keeper of British and Mediaeval Antiquities and of Ethnography at the British Museum, was born at Geneva in 1826, and educated at Eton and Trinity College, Cambridge, taking his M.A. degree in 1852. His taste for the beautiful in works of art, and his appreciation of the niceties, peculiarities, and fantasies of artists, whether the results were produced with the inspiration of genius, or by handicraft and labour, led him to collect largely in each department of artistic work, and fortunately his ample means enabled him to do so. With munificent liberality he gave many valuable collections to the National Museum at Bloomsbury. It was thus that, not only theoretically, but practically and personally, he was acquainted with the extensive and many-sided groups of antiquities and ethnographic exhibits under his keepership. He was not a mere official custodian, but a cultured connoisseur, and a high-class authority on all points connected with the scientific and historical aspects of the materials or collections in his charge. Necessarily his study of medieval things kept him in touch with those of prehistoric age in the British Collection which was under his care; and, indeed, of these there are many objects of human workmanship dating from extremely early times. Contemporary with these were similar productions in European and other countries. These are largely represented in the British Museum by the "Christy Collection," which Sir Wollaston Franks augmented by successive gifts of similar well-sorted examples from many localities. Indeed, this notable department in the museum well deserves now to be called the "Christy-Franks Collection."

In March 1864, Mr Henry Christy invited a party of his friends, interested as antiquaries and geologists, to examine some of the bone-caves on the Vezère, Dordogne district, in the south of France, which, with his friend Edouard Lartet, he had for some time been investigating with great care, and at considerable expense. The party comprised Mr W. J. Hamilton (President of the Geological Society), Prof. Rupert Jones (Assistant Secretary of the Geological Society), Capt. (since Sir) Douglas Galton, Mr (since Sir) John Lubbock, Mr (since Sir) John Evans, and Mr (since Sir) A. W. Franks.* Not only had the last-named already interested himself in Henry Christy's researches in the ethnographic relationship of various textile fabrics, which had led him to Mexico, and in that country to the observation of stone implements; but A. W. Franks heartily joined Christy in the study of stone implements, and of those who

* *Quart. Journ. Geol. Soc.*, vol. xx., 1864, p. 444; and "Reliquiae Aquitanicae," Part xii., 1873, p. 161.

made and used them, whether ancient peoples, recent savages, or living workmen in some modern trades and manufactures. Together with Dr Hugh Falconer, he aided H. Christy and E. Lartet in planning their great work, "Reliquiae Aquitanicae," which was intended to comprise descriptions of all the Dordogne caves and their contents. Unfortunately the death of both Christy and Lartet circumscribed the work within smaller limits, for no more caves were worked out by them, and but few plates were subsequently added to the eighty or more already lithographed for its illustration. It is noticed, we see, in the preface of the book that, "In bringing together and arranging the varied materials supplied by friends at home and abroad desirous of making the "Reliquiae Aquitanicae" useful in archaeology and anthropology, the directing counsels of Mr A. W. Franks, F.R.S., have been constant and efficient, like his courtesy and knowledge."

He took charge of the "Christy Collection," at 123 Victoria Street, S.W., for some time before it was transferred to the British Museum; and he individualised the specimens with accurate drawings by his talented assistants—first, T. K. Gay, and subsequently Charles Read. The latter worthily succeeded Sir Wollaston on his resignation, in 1894, as keeper in the British Museum.

It was with great caution that Sir Wollaston exercised his judgment as to the authenticity of implements of stone and their relative age. He was not an enthusiast in the subject of the great antiquity of the Human Race. Possibly, had he been induced to give more leisure to the study of the geological aspect and details of the subject, he might have become cognisant of the value of Sir Joseph Prestwich's researches in the geological age of some of the older groups of flint implements, especially of those collected with earnest and intelligent care at Ightham, in Kent, by Mr Benjamin Harrison (see *Natural Science*, Vol. V., p. 269, Oct. 1894).

Sir A. Wollaston Franks contributed largely to scientific literature, especially by memoirs and notices in the Transactions and Proceedings of learned societies. He has greatly enlarged the knowledge of antiquities and their real relationships, not only by original research, but by his willing advice and ready information to enquirers, whether in London or the provinces. He has bequeathed his collections to the British Museum. He was elected to the Royal Society in 1854. For many years an active and valued Fellow of the Society of Antiquaries, he was elected Director of the Society in 1858. Subsequently for some years he was Vice-President, and eventually he became President in 1892. T. R. J.

JULIUS VON SACHS

BORN OCTOBER 2, 1832. DIED JUNE 1897

WE regret to announce the death of Professor Julius von Sachs, the botanist, who perhaps more than any other is responsible for the present position of his science—be it good or bad—at any rate from the point of view of the university or college curriculum. His "Lehrbuch der Botanik," or its English translation, was for more than twenty years the text-book for advanced students; and even now it holds an honoured place in all botanical libraries.

Born at Breslau sixty-five years ago, Sachs studied in the German University of Prague, and in 1851 became assistant to Purkinje. In 1856 he was appointed Privatdocent for Plant Physiology in the same University. In 1861 he was called to the Chair of Botany in the Agricultural Academy of Poppelsdorf; six years later he removed to Freiburg; and finally in 1868 he obtained the Professorship of Botany at Würzburg, which he held until his death.

Sachs was a hard worker and a voluminous author. The Royal Society's catalogue enumerates 92 papers up to 1883 only. The first, on the crayfish, appeared in *Ziva*, a periodical printed in Bohemian, and published at Prague. If we turn over the numbers of *Ziva* for a few years from 1853 onward, the great energy of the man and the bent of his mind towards the morphology and physiology of plants is evident. Among the excellent figures which accompany the text and which alone appeal to most of us, we see the originals of many which have since become classical. Besides his Text-book of Botany, the Clarendon Press has put two other of Sachs' useful works within the reach of all English-speaking students—the "Lectures on the Physiology of Plants," translated by Prof. Marshall Ward, and the "History of Botany." Some idea of the amount of his work may be gained from the size of the collected contributions to plant physiology, published in 1892-3, which form a book of more than 1200 pages, large octavo. The relation of temperature and light to the living plants, chlorophyll and assimilation, the measurement of water through the tissues, and the transport of food-material, are the very wide headings under which his work in this branch is grouped. Besides his numerous papers in the *Botanische Zeitung; Flora*, and many other German periodicals, Sachs founded and edited the *Arbeiten des Botanischen Instituts in Würzburg*, the first volume of which appeared in 1874, and the third and last in 1888. They represent mainly his own work or that of his pupils, many of whom have since become well known as investigators and teachers.

FRITZ MUELLER

BORN 1822. DIED MAY 21, 1897

THIS eminent helminthologist, carcinologist, and field-naturalist died last month at his residence in Blumenau, Santa Catarina, Brazil. His earliest contributions to science appeared in Wiegmann's *Archiv für Naturgeschichte* in 1844, and were written under the Christian name of Friedrich. Later on he appeared as Fritz, again as Friedrich, and in more recent publications as Frederico—a series of changes which have confused not a few librarians. So far as his contributions to periodical literature are concerned, the list in the Royal Society's catalogue is correct, and in the tenth volume of that work we read that Müller's full name was Johann Friedrich Theodor Müller. The latter, no doubt, was information received from himself, but Müller does not mention this fact in a sketch of his life in his own hand that lies before us. He was a voluminous and steady worker, but his chief claim to remembrance is his book, "Für Darwin," which was a first-class contribution to the subject of Natural Selection, and was translated into English as "Facts and Arguments for Darwin," by the late W. S. Dallas. C. D. S.

BARON OSCAR DICKSON, who died at his estate Almnäs, near Gothenburg, on June 5, aged 73, used his opportunities as one of the wealthiest men in Sweden to succour all scientific and educational enterprise, and especially geographical explorations, most notable among which has been the voyage of the Vega through the north-east passage under Baron Nordenskjöld. Some years ago Baron Dickson offered to contribute largely to an Antarctic expedition under the command of Nordenskjöld, if the Australian colonies would help, but the scheme fell through.

There are also announced the deaths of:—MARTIN L. LINELL, assistant in the Department of Insects in the U.S. National Museum, aged 47; C. A. L. ROBERTSON, one of the editors of the *Journal of Mental Science*, and well known through his work in medical physiology; H. V. CARTER, for many years Professor of Anatomy and Physiology in the Grant Medical College at Bombay; E. RUSSOW, ex-Professor of Botany at Dorpat, on April 23, aged 56; CH. SCHOLZ, Professor of Geodesy in the Polytechnicum at Delft; TRAILL GREEN, first President of the American Academy of Medicine, and author of the "Floral and Zoological Distribution of the United States"; Dr DEROUBAIX, Professor of Medicine at Brussels University and assistant Court Physician, on May 22, aged 84; ANTOINE T. D'ABBADIE, formerly President of the Academy of Sciences at Paris, and the author of many valuable works on geographical exploration and geodesy; JOSEPH F. JAMES, at Hingham, Mass., on March 29 (of pneumonia), teacher of botany at the Cincinnati College of Pharmacy, Miami University, and Maryland Agricultural College, and formerly connected with the Division of Vegetable Physiology and the U.S. Geological Survey; EMILY L. GREGORY, professor of botany at Barnard College, U.S.A.; JAKOB BREITENLOHNER, professor of meteorology and climatology in the College of Agriculture, Vienna; SINKU SAKAKI, professor of psychiatry in the University of Tokyo; PETER D. KEYSER, formerly professor of ophthalmology at the Medical Chirurgical College, Philadelphia, and surgeon to the Wills Eye Hospital; LUDWIG HOLLAENDER, who wrote on dental anatomy; DR FEULARD, a well-known dermatologist, in the fire at the Paris charity bazaar; LUCIEN BIART, a French physician in Mexico, who had sent thence botanical and ornithological collections to the Paris Museum; L. JURANYI, professor of botany at the R. University of Hungary, and director of its botanic garden, on Feb. 27, at Abbazia, aged 59; EDSON SEWELL BASTIN, professor of materia medica and botany at the Philadelphia College of Pharmacy, and author of an "Elements of Botany," aged 54; the entomologist, C. J. J. M. BUGNION, on Jan. 19, at Lausanne, aged 86; the coleopterologist, J. HAMILTON, of Alleghany city, on Feb. 12, in Florida, aged 69; WILHELM HORN, director of the forestry research station in Brunswick, on April 4, aged 68; MRS ALICE BODINGTON, a well-known and accurate populariser of science, at New Westminster, B.C.; the coleopterologists, H. D'ACHON in Orleans, and V. MAURICE TEINTURIER in Clayeures, France; at the beginning of April, the professor of geology and paleontology at the Neufchatel Academy, LEON DU PASQUIER, aged 33; VICTOR LEMOINE, of Reims, who investigated the vertebrate fossils of the Lower Tertiary deposits near that city; EDMUND NEMINAR, formerly assistant Professor of Mineralogy and Petrography at Innsbruck University, on April 10, in Vienna; KARL KOLBEL, curator at the State Natural History Museum in Vienna, and specialist in Arachnida, Myriopoda, and Crustacea; on Ponape, one of the Caroline Islands, J. S. KUBARY, who had a wide acquaintance with the fauna and flora of the South Seas; on Feb 7, in Lyons, the botanist, ALEXIS JORDAN, author of "Icones ad Floram Europae," aged 83; on Feb. 17, at Ashton-on-Ribble, the entomologist, J. B. HODGKINSON, aged 73; FRIEDRICH WILHELM KLATT, teacher of botany in Hamburg, on March 3; GEORGE W. TRAILL, the marine algologist; on Feb. 7, in Moscow, the curator of the Zoological Museum, ALEXANDER N. KORTSCHAGIN, carcinologist; on Feb. 27, at Luebo on the Kassai, Congo State, the Belgian botanist, ALFRED DEWÈVRE; on Feb. 28, at Grange-over-Sands, the Rev. JOHN EDWARD CROSS, author of a paper on the geology of N.-W. Lincolnshire, aged 73; on March 18, in Cassel, the ichthyologist, FRIEDRICH SEELIG, aged 69; Prof. HERMANN FRIEDRICH KESSLER, student of Aphides in Cassel; HEINRICH WANKEL, anthropologist, in Olmutz, aged 76; EMILE MAGITOT, President of the Société d'Anthropologie of Paris, and an eminent odontologist; A. STOCQUART, Professor of Vertebrate Anatomy at Brussels, aged 40; LEOPOLD MANEN, correspondent of the Paris Academy of Sciences in the section of Geography and Navigation, in May last; on Jan. 23, in Baltimore, Md., JOSEPH EWING MACFARLAND, who was connected with the U.S. Geological Survey, and had been doing field work in Tennessee; HUGH NEVILL, of the Ceylon Civil Service, at Hyères, on April 10, formerly editor and publisher of the *Taprobanian*, and a successful collector of zoological specimens, as well as of Ceylonese antiquities; Madame JEAN DOLLFUS, who for many years conducted *La Feuille des jeunes Naturalistes*, founded by her son, E. Dollfus.

NEWS

THE following appointments are announced:—
W. Garstang, of Lincoln College, Oxford, to be Naturalist to the Marine Biological Association of the United Kingdom; Dr Charles W. Dabney, jun., to be special agent in charge of Scientific and Statistical Investigations in the U.S. Department of Agriculture; Dr J. L. Prevost, to be full Professor of Physiology at Geneva; Dr E. Kaufmann, privat-docent in Anatomy at Breslau, to be Professor; Dr Max Wolters, privat-docent in Anatomy at Bonn, to be Professor; A. J. Moses, to be Professor of Mineralogy, and H. M. Howe, to be Professor of Metallurgy, in Columbia University; W. H. Lang, to be Lecturer, and Miss D. Clark, to be Demonstrator in Botany, and Miss M. Maclean, to be Demonstrator in Anatomy, at Queen Margaret College, Glasgow; Dr Fritz Frech, to be Professor of Geology and Paleontology, at Breslau; Dr Walter Kruse, to be Professor of Hygiene, at Bonn; D. W. Ule, to be Professor of Geography, at Halle; Dr Raphael Slidell, Freiherr von Erlanger, and Dr Paul Samassa, privat-docents in Zoology, at Heidelberg, to be Assistant-Professors; Dr J. Thomayer, to be Professor of Pathology, at the Bohemian University, Prague; Dr E. B. Copeland, to be Assistant-Professor of Botany in the University of Indiana, as successor to Dr G. J. Peirce, who becomes Professor of Plant Physiology in Leland Stanford Junior University; Dr Ivan V. Muschketoff, to be full Professor of Geology, at the Mining Institute, St Petersburg, in place of A. P. Karpinski, resigned; Dr A. Stoss, Prosector at the Veterinary College, Munich, to be Assistant-Professor in place of Prof. Johannes Ruckert, who goes to the University; at the Geologischer Reichsanstalt, Vienna, A. Bittner, as Chief Geologist, G. Geyer, as Assistant-Geologist, G. v. Bukowski and A. Rosiwal, as Adjuncts; Dr Tschirwinski, of Moscow, to be Professor of Pharmacology, at Dorpat.

THE widow of Prof. G. vom Rath has presented his library to the University of Bonn.

MR F. D. GODMAN has been elected president of the British Ornithologists' Union.

MR H. H. W. PEARSON has received from Cambridge University a grant of £100 for botanical research in Ceylon.

THE National Herbarium, U.S.A., is sending an expedition under Mr E. P. Sheldon, late of Minnesota University, to explore the Blue Mountains, Oregon.

THE memorial to the African explorer, Joseph Thomson, at his native place, Thornhill near Dumfries, was unveiled on June 8, by Sir Clements Markham.

THE *Windward* has taken out special stores for Mr Andrée, in case he meets with any accident and should be obliged to seek safety on Franz Josef Land.

A HISTORY of the Berlin Academy of Sciences is to be prepared by Prof. Harnack, and to be published on the 200th anniversary of the Academy's foundation.

THE city of New York is raising a loan of 500,000 dollars for the erection of a further wing to the American Museum of Natural History.

THROUGH the influence of President David Starr Jordan, says *Science*, arrangements have been made for the establishment of zoological gardens in San Francisco.

CAPTAIN ABNEY, who delivered the sixth Robert Boyle Lecture before the Oxford University Junior Scientific Club on June 1, took for his subject "The scientific requirements of colour photography."

THE first award of the Tilanus gold medal, to be decided every five years by the University of Amsterdam, has been made to Dr Zwaardemaker of Utrecht, for his work on the physiology of smell.

WE much regret to hear that there is talk of withdrawing the Government subsidy to the fresh-water biological station at Plön, where, under Dr Otto Zacharias, so much valuable work has been accomplished.

THE Russian Geographical Society and Academy of Sciences are sending an expedition to study the geography and natural history of the khanates of Roshan, Shignan, and Darwaz.

MR R. C. L. PERKINS, who has been investigating the zoology of the Sandwich Islands for a committee of the British Association and Royal Society has returned to England.

THE following numbers of students at the Imperial College of Science, Tokyo, were recently given by *Engineering*:—Mathematics, 11; Astronomy, 2; Physics, 30; Chemistry, 15; Zoology and Botany, 12; Geology, 14. In all there are 89 students.

DR LOUIS GRÉHANT, Professor of Physiology at the Musée d'Histoire Naturelle, Paris, has been awarded 4000 francs by the French Government to assist his researches on the hygienic applications of physiology.

AN important change has just been made at the Spanish universities and other educational institutions under State control. Foreigners are now allowed to study there and to enter for the examinations, and to take degrees at the universities.

THE Shute Scholarship in Animal Morphology, recently founded at Oxford University, has an annual value of £50, and is attached to no college. The examination takes place this July, and is open to all who may be in need of assistance at the university, and who have not been members of the university for more than eight terms.

THE late Prof. Newberry, having left funds for the encouragement of scientific research, it has been decided to apply the grant successively to geology and palaeontology, zoology, and botany. A sum of 50,000 dollars will be awarded in the first subject, on July 15, to competitors from among the Scientific Alliance of New York City.

CAMBRIDGE UNIVERSITY has made a grant of £300 to Prof. A. C. Haddon, to enable him to make an expedition to the Torres Straits to continue his researches on the anthropology of that region. He will be accompanied by other anthropologists from Cambridge, and by an expert in Melanesian languages.

THE International Congress of Medicine and Surgery meets this year at Moscow during August. The Russian Government has not only contributed some £8000 towards the expenses, but has arranged for a two weeks' excursion to the Caucasus, in the course of which the mineral springs of Kislovodsk will be visited.

A LABORATORY for the study of cavernicolous animals has been started by Mr Armand Viré in some subterranean passages, recently rediscovered beneath the Jardin des Plantes and the Boulevard St Marcel, Paris. Water is supplied from springs by means of pipes.

IT is expected that the *Belgica*, the ship of the Belgian Antarctic Expedition, will arrive at Antwerp early in July, and that the expedition will start in August. The expedition will stay from October to March on the eastern shore of Graham's Land. The following year, after re-coaling and provisioning at Melbourne, it will visit Victoria Land.

A SURVEY of the Pribyloff islands is now being carried out by the U.S. Coast and Geodetic Survey.

The Danes are charting the northern part of the east coast of Greenland, with the help of some £1000 contributed from the Carlsberg Fund.

THE Rev. Prof. Thomas Wiltshire, of Trinity College, Cambridge, for many years treasurer of the Geological Society of London, has presented his library of scientific works to the Woodwardian Museum, Cambridge. The donation comprises about 600 volumes and 900 pamphlets.

THE Belgian Government has convened a second International Bibliographic Conference at Brussels, on August 2-4. Those who do not already subscribe to the Institut International de Bibliographie may become members for a subscription of 20 francs, on application to the Institut, 1 Place du Musée, Bruxelles. Among other subjects for discussion is the state of bibliography of the different sciences.

THE Geological Department of the British Museum (Natural History) has just obtained an interesting series of teeth and jaws of the dwarf elephant discovered a few years ago by Dr Hans Pohlig in the cavern of Carini, near Palermo, Sicily. The species seems to be *Elephas mnaidriensis*, the largest form met with in the bone-caves of Malta. It may be merely a dwarfed race of the existing African elephant, which was stranded and gradually became extinct on the islands of Malta and Sicily when the land barrier, which once existed in that region between Africa and Europe, became destroyed.

A STATEMENT has lately appeared in many scientific journals that there exists on the Pamirs a dwarf tribe, with dwarf domestic animals. This appears to have

originated from a journalist of St Petersburg. Lieut. Olofsen explains that the reference must simply have been to the Wakhanis, who are of true Aryan type and by no means dwarfs, although, owing to their mixture with Mongolians, they are not tall. Their domestic animals are half-starved but not dwarfed. Neither do the Wakhanis worship fire, as has been reported.

LIEUT. PEARY, having obtained five years' leave of absence, will start about July 10 for Whale Sound on the N.-W. coast of Greenland, leaving scientific parties on the coast of Labrador, Baffin Land, and Greenland. In July of next year, Lieut. Peary, accompanied by a surgeon and six families of Esquimaux, will push up the coast from Whale Sound to Osborne Fjord (81°N.), where he will establish a base of supplies in charge of some of the Esquimaux. About March of 1899 he will start for the north limit of Greenland, wherever that may be, and for the Pole.

THE Botanical Society of America will meet in Toronto, on August 17 and 18, immediately before the meeting of the British Association, under the presidency of Prof. J. M. Coulter. Dr C. E. Bessey, retiring president, will deliver his address on Tuesday at 8 P.M. All foreign botanists, of whom many are likely to be in Toronto, are invited to be associates of the society and to read papers.

THE following bequests of the late E. D. Cope are mentioned by *Science*: His scientific books, osteological collection, and collection of fresh-water molluscs, to the School of Biology of the University of Pennsylvania; his collection of minerals to the university; duplicates of fresh-water mollusca to the Cincinnati Society of Natural History and the American Museum of Natural History; spirit-specimens and skins to the Philadelphia Academy of Natural Sciences. The palaeontological collections are to be sold in three lots, viz. (1) the North American, (2) the South American, from the Pampean formation and West Indies and Mexico, (3) European collections, chiefly from the Neogene of Allier, France. After the payment of private bequests, the money arising from this is to found a professorship or curatorship in vertebrate palaeontology at the Philadelphia Academy of Natural Sciences.

AN important and urgent work is the collection of anthropological data from races that are disappearing or losing their old customs. For this purpose Mr Morris K. Jessup, president of the American Museum of Natural History, is fitting out an expedition under the leadership of Prof. F. W. Putnam, assisted by Dr Franz Boas. They will proceed up the north-west coast of North America, cross Bering Strait, and so pass down through eastern Siberia into China, and thence along the Indian Ocean to Egypt. The expedition will be away six years, and is expected to cost over 60,000 dollars. The special problem to be studied is the relation of the American races to those of Asia and Africa.

HENRY G. BRYANT, of Philadelphia, accompanied by S. J. Entrikin and E. B. Latham, has started for Alaska for the purpose of climbing Mount St Elias and making explorations in the adjacent region. Mr Bryant, says *Science*, has had experience of exploration in Labrador, and has made summer trips to Greenland. Mr Entrikin was with Peary in Greenland and made an expedition over the inland ice. Mr Latham is a member of the U.S. Coast Survey, and goes equipped for geographical work. The party, having established a base camp on the west shore of Yakatat Bay early in June, will cross the Malaspina glacier to the Samovar Hills; from there ascend the Agassiz glacier, and thence up the Newton glacier to the divide between Mount Newton and Mount St Elias. A camp will be established on the divide, elevation about 13,000 feet, from which the ascent to the summit of Mount St Elias will be made. On returning to the Samovar Hills the explorations will be continued westward through an entirely unknown region until a pass is discovered which will enable the explorers to cross the St Elias Mountains and gain one of the branches of Copper River. The return to the coast will be by way of Copper River. The party is well equipped, and has every prospect of success.

A PHOTOGRAPH of the new South African Museum at Cape Town, which, as we have stated, was recently opened, is given in *Nature* for May 13. The building is at the upper end of the Municipal Gardens, and consists of two floors, the upper of which contains the principal exhibition rooms. A room 63 by 41½ feet contains the birds, reptiles, and fishes of S. Africa, recent and fossil, while a room of equal size holds the general collection of vertebrates. The S. African mammals are in a smaller room, and another contains the anthropological collections both S. African and general. On the ground floor are four exhibition rooms, the two larger containing the invertebrates and the general geological collection; the two smaller, the collection illustrating S. African geology and mining and the local antiquities. Other rooms on this floor contain the library, study collections, and offices. The taxidermist's shop and store-room are in a separate building. All the cases are made of glass and iron (see Dr Meyer's letter in *Natural Science*, vol. ix., p. 142, Aug. 1896).

THE Auckland Institute has decided to add a new hall, 50 feet square, to its museum, on the east side of the ethnographical hall. It is intended to receive the statuary presented by Mr T. Russell, C.M.G., which has hitherto found an incongruous home among stuffed vertebrates. The space thus gained will be occupied by groups of the larger mammals, and £100 offered by Mr Russell will be used to procure a group of the larger carnivores.

Little Barrier Island, on which an attempt is being made to preserve the indigenous fauna and flora of New Zealand, has been placed under the control of the Institute, with a grant of £200 for the first year's expenses. Mr R. H. Shakespear has been appointed curator, and it is hoped that he may be able to stop the depredations of collectors.

MR H. C. CHADWICK has been helping Mr J. J. Ogle at the Bootle Museum, and has rearranged much of the zoological series with elucidatory diagrams. Many new exhibition cases have been acquired, and in one of these the birds are to be rearranged, after consultation with a specialist. The museum lends specimens to teachers for the illustration of object-lessons, and the curator himself gives lectures, illustrated by the lantern, which appear to be much appreciated by young people.

ACCORDING to the *Halifax Naturalist*, the Natural History Museum of Halifax, which was handed over to the County Borough Council about eighteen months ago by the Literary and Philosophical Society, has now found a permanent home in the old mansion named Belle Vue. The geological and botanical collections are very extensive and valuable, but zoology is as yet very imperfectly represented. The herbarium has lately been much enriched by the fine Gibson collection of British plants, the gift of Lady Trevelyan. The Curator, Mr Arthur Crabtree, is making a praiseworthy attempt to render the Museum of general educational value by adequate labelling, and we sympathise with him in his aspirations for a competent committee of management to direct and second his efforts. As he remarks, the ordinary municipal committees may be very admirable bodies, but they are not able to comprehend the requirements of a Museum of Natural History. He needs a committee of naturalists, of which there is no lack in Halifax, and his proposals deserve to be carried out immediately.

WE learn from *L'Anthropologie* that the Museum of Moscow University has recently received from the Commission of the Archives of Riazan a collection of skulls, mostly prehistoric, of which the locality and conditions of finding are known in each case.

The same journal informs us that, near Elissavetpol, in the Caucasus, there have recently been found by seekers after copper, at a depth of 3 metres, a massive bronze bracelet and a copper spear-head of quadrangular shape and 35 cm. in length. In the same locality, on the banks of the Tchovdar, are traces of prehistoric mining.

Some three thousand prehistoric objects in bronze, iron, bone, and pottery, have been found on the site of ancient places of sacrifice of the Tchoudes at Gliadenevo, on the left bank of the Kama, near Perm.

At Chita in Trans-Baikal, the local branch of the Russian Geographical Society has founded a museum, which already contains valuable natural history, archaeological, and Buddhistic collections.

ON September 15, 1896, the National Museum of Costa Rica was definitely installed in its new quarters, a two-storeyed building. A view of it is given in *La Revista Nueva* for October 1896.

Referring to this museum in his always valuable "Current Notes on Anthropology" (*Science*, March 19), Prof. D. G. Brinton says that few localities in America offer better specimens of aboriginal pottery and stone-work. The most abundant remains were left by the Guetares, a tribe of whose language and affinities we are still ignorant.

PLENTY of attempt has been made to introduce some study of common objects or of nature into our elementary schools; but the obstacle generally lies in the teachers. A similar difficulty is felt in America, and to meet it the college of agriculture of Cornell University has undertaken to help, free of expense, all teachers who may wish to be put in the right way.

The same subject has been fully studied by a committee of sixty, appointed in May 1896, by the Chicago Institute of Education, and this committee has appointed sub-committees to prepare maps of the neighbourhood, to prepare printed outlines and suggestions for teachers, to look after appropriate books in the Chicago libraries, to supervise the work of instruction and keep touch with the individual teachers, and also to establish an exhibit of appliances, to arrange cheap means of transport, and to see to finance.

THOSE who are advocating the extension of the study of experimental psychology in this country will be glad to hear that it is proposed to establish a lectureship in that subject, including the physiology of the senses, at Cambridge University. They will not be so glad to hear that the salary is fixed at £50 per annum. Lecturing in an experimental science is not much use; one wants experiments, and for those one wants apparatus and a laboratory.

THE books bearing on lichens and the dried specimens belonging to the late Dr J. Müller, generally known as Müller-Argau, became at his death the property of the Boissier Herbarium, at Chambésy near Geneva. Following the example of the trustees of another important lichenological library, the "Tuckerman Memorial Library" at Amherst College, Massachusetts, the directors of the Boissier herbarium have instituted the "Foundation Müller-Argau," and the curator, M. Eugène Autran, now appeals to botanists generally for copies of publications bearing on lichens which have appeared since Müller's death, or may hereafter appear. Also that specimens of new or rare species, or "materials for morphological and biological research" may be deposited in the Lichenotheca Universalis Müller-Argau, in which is included the herbarium of the Bernese F. Schaerer (1785-1853). Gifts will be acknowledged in the *Bulletin* of the Boissier herbarium.

IN connection with the Autumn Meeting of the Iron and Steel Institute at Cardiff, on August 3rd to 6th, Professor Herman Wedding of the Berlin School of Mines has issued a circular letter asking for subscriptions towards establishing a Central Laboratory for the Testing of Iron and Steel. Such a Laboratory would be founded at Zurich under the auspices of the International Society for the Unification of the Methods of Testing Materials of Construction, which was formed in 1895, and the proceedings at which were reported in the *Journal of the Iron and Steel Institute* for 1895. The Secretary of the Institute, Bennet H. Brough, has consented to receive the names of those who are interested.

THE Radcliffe Library at Oxford is known to scientific men for its wealth in their peculiar literature, and to librarians for the excellence of its arrangements. Such libraries grow rapidly nowadays. Want of room long felt has urged the Drapers' Company to offer to erect a new building, from plans by Mr T. G. Jackson, at a cost of £15,000. The offer has been gratefully accepted by the University, which proposes to transfer the space thus gained in the museum to the medical school, and especially to start a library of pathology.

THE new museum at Winchester College, built as a memorial of the quingentenary of the school's foundation, was formally opened on June 16, 1897. There was an interesting exhibit of Wykehamical antiquities, and the art department made a fine show, but the arrangement of the natural history collections has hardly begun. When these last are more advanced, we shall hope to give a detailed account of the building and its contents in our series: Museums of Public Schools.

THE first annual meeting of the South-Eastern Union of Scientific Societies was held at Tunbridge Wells at the end of May. The Rev. T. R. R. Stebbing presided, and delivered the inaugural address. He dealt with the changes in the attitude of the public mind towards scientific research within modern times. Mr W. Cole contributed the first paper on the objects and methods of local museums, referring especially to the new Epping Forest museum. Prof. Boulger next discussed the duties of the committees of Field Clubs. Prof. Seeley described a geological section in the New Athletic Ground at Tunbridge Wells, showing current-bedding in clay. "The Search for Coal in the South-East of England," the subject of a paper by Mr H. E. Turner, led to a long and interesting discussion. The Mayor of Tunbridge Wells extended his hospitality to the assembled delegates, and an interesting geological excursion terminated the proceedings.

CORRESPONDENCE

OCEANIC ICHTHYOLOGY

THE reviewer of Goode and Bean's "Oceanic Ichthyology" (*Natural Science*, vol. x., pp. 338-340) has made a gratuitous assumption, which devolves on me unmerited credit and responsibility.

The reviewer says "it is to be noted that the literary part of the work bears signs of having been intrusted to a third author not under proper control of the two responsible authors." The "third author" is evidently myself. I feel compelled to deny either credit or responsibility for all that is not specifically accredited to me. Dr Goode devoted much time and thought to the keys, and I had nothing to do with the original compilation.

The specific information that certain fishes have and others have not a mesocoracoid, so far as the italicised portions credited to me are concerned, I am responsible for, but not entirely for their application.

The critic remarks, "as a matter of fact, the vast majority of the fishes placed here have not been examined with reference to this point." True; but enough have been examined to authorise the deduction formulated. The same argument might be adduced against other generalisations. . . .

As to the definition of Pterothrissidae, it will be evident from the context that the mistake is due to unintentional repetition instead of the requisite antithesis. The family Alepocephalidae is defined as having the "dorsal fin similar and opposite anal," and the Pterothrissidae should have been contrasted as having the dorsal fin unlike, and longer than anal. Undoubtedly carelessness and oversight are manifest, and I am willing to assume that I glanced over the proof and therefore to share the blame, but I had nothing to do with the original manuscript. Drs Goode and Bean, as well as myself, had much on hand, and doubtless the proof sheets were often read in a perfunctory manner. But in this respect, we have good company. . . .

Such mistakes unfortunately are too common and are generally designated as "slips of the pen" or "lapsus calami." I do not defend them, but it does not become the guilty to animadvert on them too strongly. . . .

What are or what are not family characters, is a question about which Dr Günther and I have long differed, and I wish neither to defend my view nor to attack those of others on this occasion. All the many American naturalists, at least, agree with me on such points. Other strictures I leave to the surviving of the authors, if he should deem them worthy of attention.

Some notice of the remarkable novelties obtained since the publication of the results of the *Challenger* Expedition might have been given by the reviewer, but I shall not trespass further on your space to do so. THEO. GILL.

[We regret that Dr Gill should assume our review of Goode and Bean's "Oceanic Ichthyology" to have been written or inspired by Dr Günther, who had no share whatever in its preparation. Like many unsigned reviews in *Natural Science*, it was the work of more than one author, and expressed the views of the editorial management of this journal, not those of any one individual. We have therefore omitted from Dr Gill's lettter some remarks on Dr Günther's works.—ED. *Nat. Sci.*]

SLUGS

I HAVE recently received from an American malacologist a communication, in which he says that in a paper,* written in conjunction with Lieut.-Col. H. H. Godwin-Austen, I have "wrongly applied the term slug by using it for such genera as *Parmarion*, *Microparmarion*, &c."

It is very largely a question of individual opinion as to what genera should be included under this term, but I fail to see any reason why *Parmarion* and its allies should not be termed slugs.

The slugs are not a group by themselves which can be separated into distinct families apart from the rest of the Pulmonata. On the other hand, very many genera are closely related to genera in which there is a conspicuous shell. In the abovementioned paper the same opinion was expressed as follows:—"We think that future

* Proc. Zool. Soc., 1895, p. 249.

research will clearly show that many of the slugs cannot rightly be placed in families by themselves, but will find their true position before or after the genera they have descended from or developed into."

I would, therefore, include amongst the slugs all forms of Pulmonate molluscs in which the shell is absent, or where, when present, it is incapable of containing the whole of the animal.—WALTER E. COLLINGE.

BUFFALO *v.* BISON

MR G. H. CARPENTER doubtless does well to be shocked; but the *Scientific American* you failed to correct has a fellow-sinner in another American, whose claim to the title scientific not even Mr Carpenter would deride. Dr C. Hart Merriam, in *Science* for May 14 last, writes: "The familiar story of the vanishing buffalo is only one of many." It is to be feared that the influence of Fennimore Cooper is still strong even with the purest of the pure scientific writers.—BUFFALO BILL.

WE have received an interesting note from Professor A. S. PACKARD, in which he refers to our recent articles on the Arthropoda. In his well-known memoir on the brain of *Limulus* (Mem. Nat. Acad. Sciences, vol. vi., 1893) he has already pointed out that there are four lines of descent among these animals. Hence he considers the group to be polyphyletic. He now writes:—"I do not believe the Crustacea and Trilobites had a common ancestry. I think they evolved from separate vermian ancestors."

OUR remarks on the so-called shooting of the golden eagle in Yorkshire have also brought us communications from Mr ERNEST BELL and MR G. W. MURDOCH. The former urges the necessity of more stringent laws for the preservation of the rare British birds; the latter takes a more hopeful view of the case. It appears that Mr F. Boyes, of Beverley, a thoroughly competent ornithologist, has personally investigated the incident referred to in Mr Joseph Collinson's letter last May (*Nat. Science*, vol. x., p. 303), and finds that the bird in question was not an eagle of any kind, but a young rough-legged buzzard. Mr Murdoch adds:—"I can bear out Mr Southwell's statement (*Nat. Science*, vol. x., p. 432) that the golden eagle is in no danger of extermination in this country."

NOTICE

TO CONTRIBUTORS.—All Communications to be addressed to the EDITOR of NATURAL SCIENCE, at 67 St James' Street, London, S.W. Correspondence and Notes intended for any particular month should be sent in not later than the 10th of the preceding month.

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